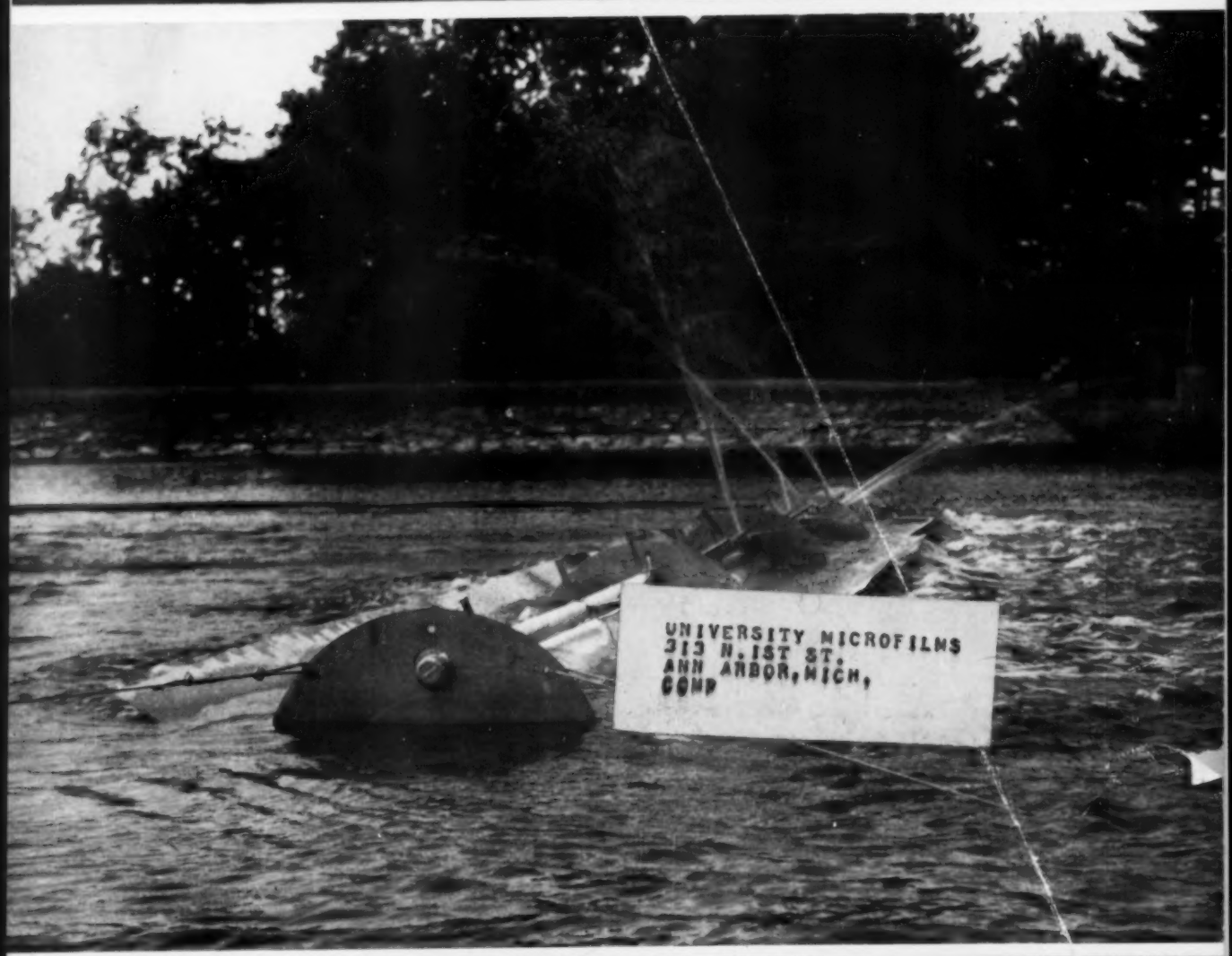
WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

A Scranton Gillette Publication



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JUNE 1957

Reservoir Aero-Circulation Yields Multiple Benefits

What Plant Managers and Operators Want in a Salesman

The Why and How of Sewage Effluent Reclamation

14 reasons why you get superior performance from acf

LUBRICATED PLUG VALVES

acf Valves on suction and discharge lines—natural gas compressor station.

acf Valves on varnish tanks of large paint manufacturer.

1. Wide Port—Maximum Flow Efficiency
2. Full Pipe Area
3. Patented Head Gasket made of tough self-lubricating Teflon*
4. Perfectly lubricated (gun or stick)
5. Tight against head leaks under any line pressure
6. Minimum number of parts
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8. No exposed seating surfaces
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10. Installed in any position
11. Compact: fits into small space; gate valve face-to-face dimensions where needed
12. Non-wedging cylindrical plug provides easy operation
13. Easily dismantled for repairs
14. Lubricant release to prevent contamination

*DuPont's tetrafluoroethylene resin. 9704

Study this list of design and operating advantages and you will see why acf Lubricated Plug Valves are meeting the requirements of thousands of plants throughout the nation.

acf Valves permit your piping system to handle fluids with maximum efficiency at minimum cost in time, labor and power. Protected seating and sealing surfaces, leak-proof head seal, non-wedging plug reduce "down time" and maintenance to a minimum.

For higher efficiency—longer life—lower cost—specify acf Lubricated Plug Valves.

acf Valves are available in semi-steel, carbon steel, bronze and aluminum.

Sizes: ½" to 24".

Pressures: semi-steel: 175 lbs. WOG to 500 lbs. WOG.

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Representatives in all principal cities.

Ask your Industrial or Mill Supply Distributor for acf Valves.

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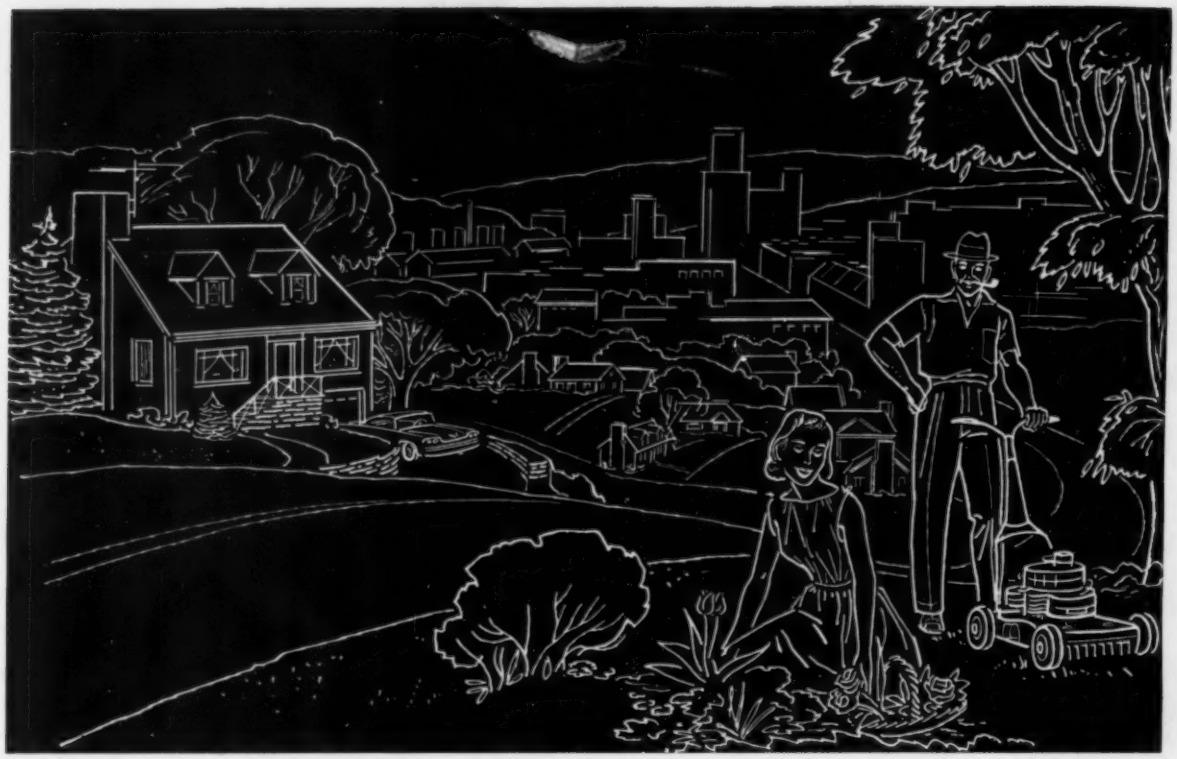
Write Dept. S-6 for new ACF Valve Catalog 400

MANUFACTURERS OF W-K-M GATE VALVES · acf LUBRICATED PLUG VALVES · KEY-KAST ALLOY STEEL PIPING FITTINGS · KEY RETURN BENDS AND FITTINGS



the billion-mile network of buried faith

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Clay Pipe has a vital job to do, and it must not fail. Yet—nobody worries about the vast underground network of sanitary protection. Few people even think about it. What greater tribute could be paid to a product's dependability?

Clay Pipe goes underground, so it's got to be good. It guards against disease, so it's got to be good. It gets no maintenance, so it's got to be good.

And you can bet your sewerage bonds it *is* good, because it's backed by a written long-term guarantee. Clay Pipe is the only pipe that *never wears out*, and the Clay Pipe industry is mighty proud of it.

THE PUBLIC *KNOWS* CLAY PIPE IS BEST

Vitrified CLAY PIPE — CLAY PIPE NEVER WEARS OUT!

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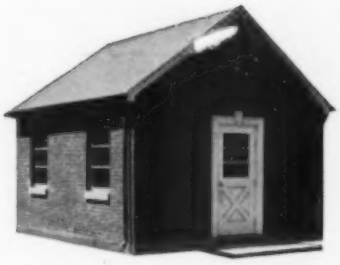
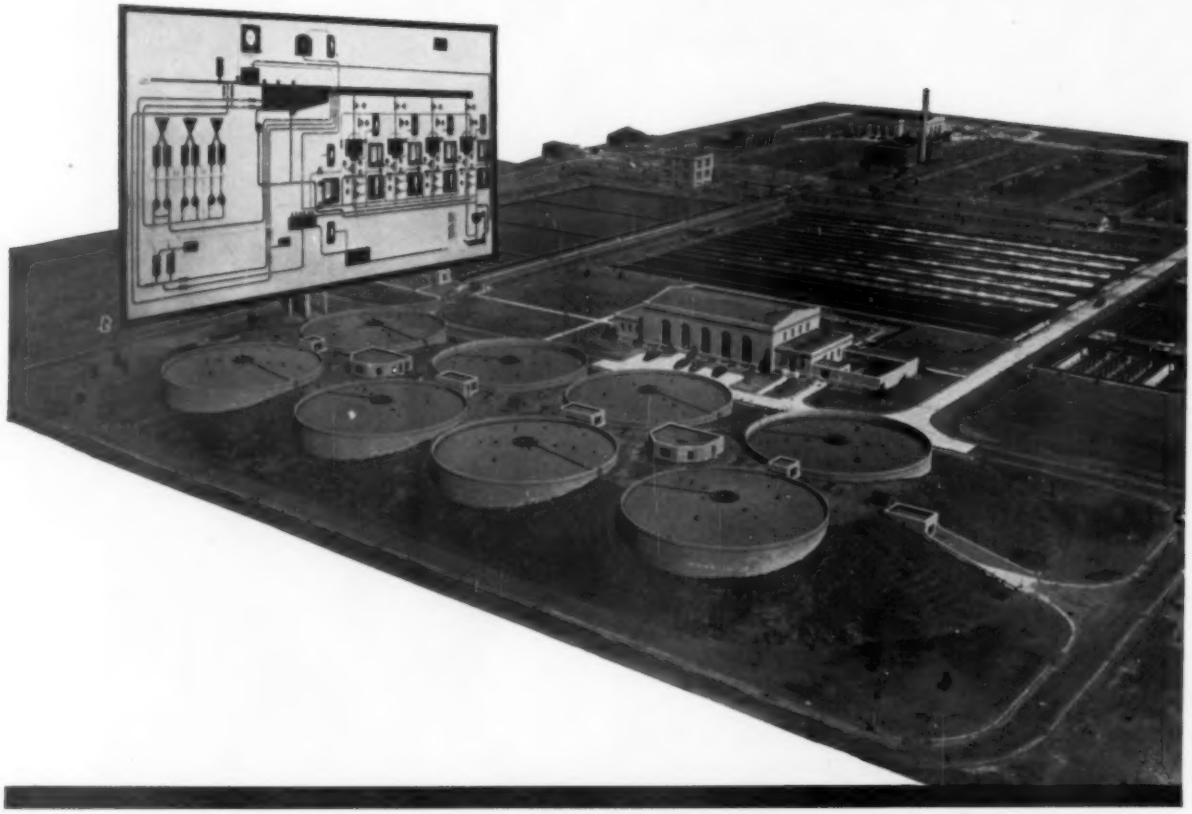


from a simple CHLORINATOR in a pumping station

to a complete CONTROL SYSTEM in a multi-million dollar plant



for water, waste, and sewage treatment

. . . consult Fischer & Porter first! Contact the Fischer & Porter field engineer serving you . . . or write Fischer & Porter Company, 167 Fischer Road, Hatboro, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 June St., Toronto, Ontario.

FISCHER & PORTER CO.

Complete Process Instrumentation

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL

Vol. 104 No. 6

JUNE 1957

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78 cents per million gallons... pumped by Westinghouse

Basic operating cost of pumping stations in the Tacoma, Washington, sewage plant is of more than usual importance in the over-all plant cost because of an unusually high gallons-per-capita-day flow through the system. Engineers found it necessary to plan for nearly three times normal.

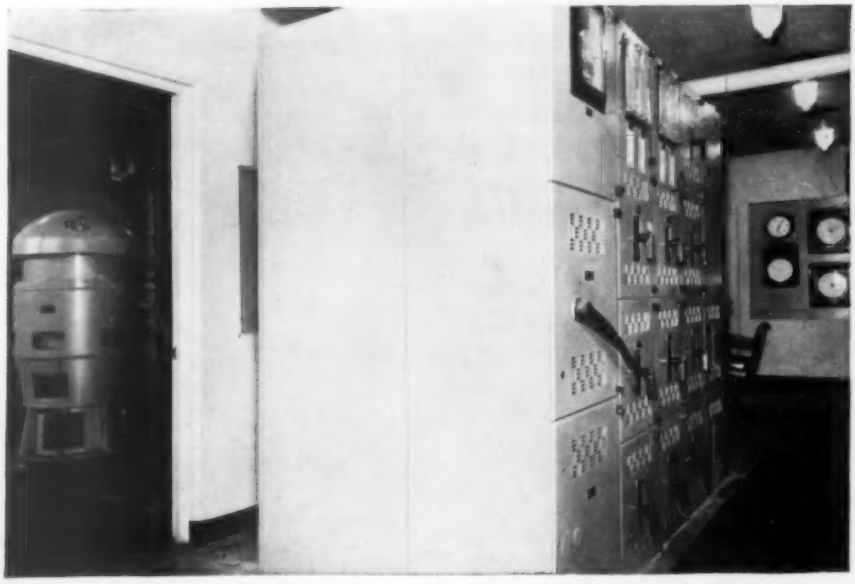
In the main pumping plant at Tacoma, four Westinghouse vertical pump motors handle the load. They are cut in and out as required and the sequence of rotation changed automatically. The station is unmanned except for periodic checks and maintenance by operators from the treatment plant.

Although the pumping requirement is high in proportion to the population served (about 67,000) the actual pumping cost is not. Yearly costs in the Tacoma plant average about 78 cents per million gallons of sewage pumped. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa. J-94075

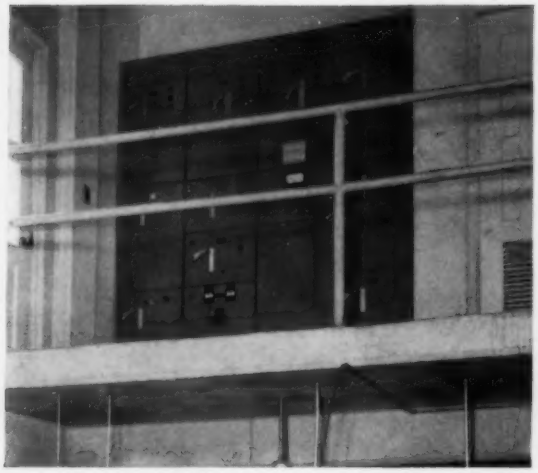
YOU CAN BE SURE...IF IT'S

Westinghouse

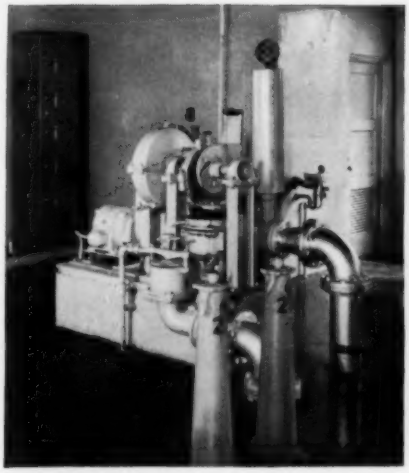
The four Westinghouse vertical pump motors in the Tacoma plant—4000 gpm, 50 hp; 8000 gpm, 100 hp; 10,000 gpm, 100 hp; 12,000 gpm, 125 hp.



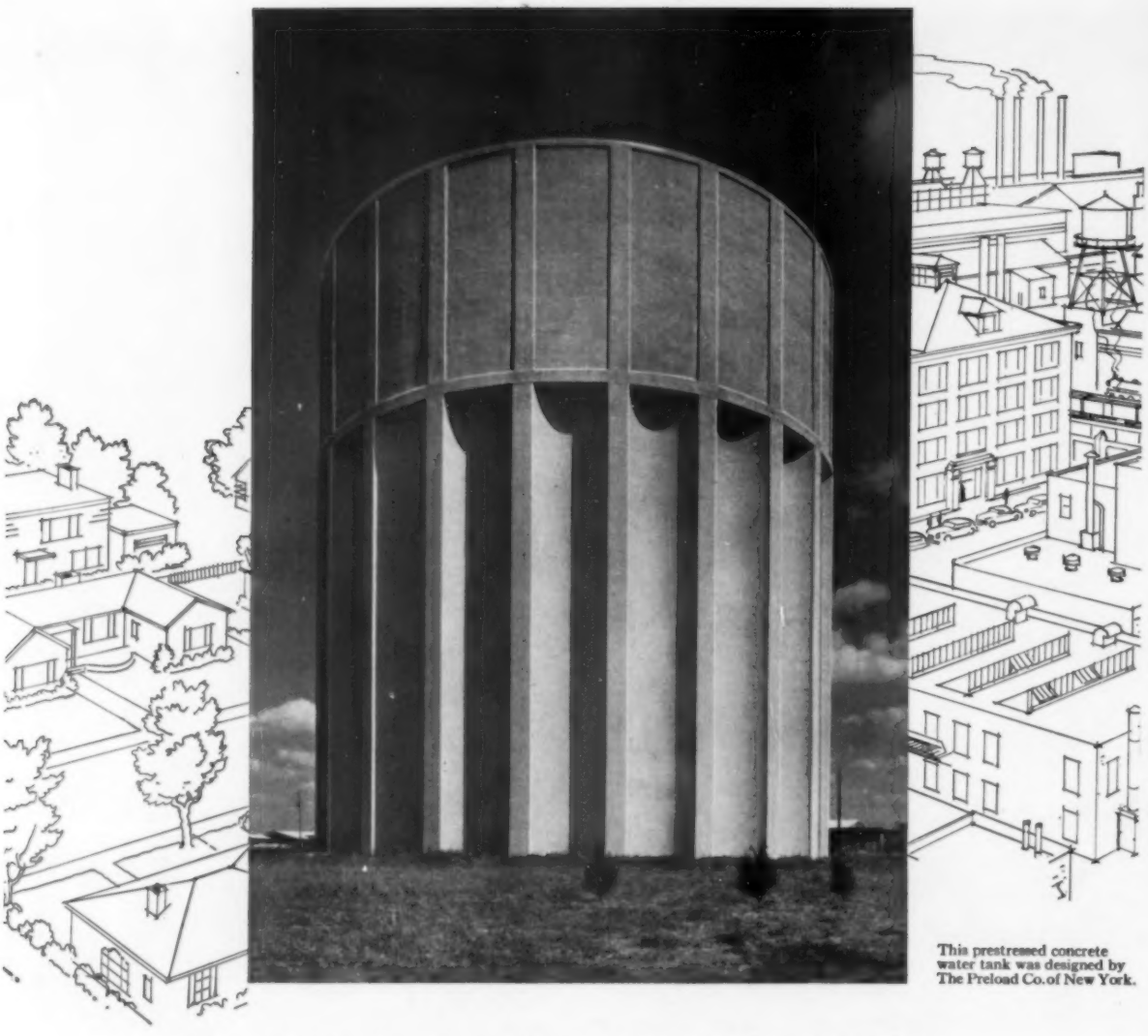
Distribution of power to motor and lighting circuits for the entire plant is through this Westinghouse switchgear, located in the main pump building.



Control center for many of the sewage plant motors, located on a balcony to conserve space, is typical of the Westinghouse unitized equipment which simplifies sewage plant electrical construction.



This Westinghouse motor drives one of the many pumps in the treatment plant. Note convenient location of control unit for this and other adjacent motors.



This prestressed concrete water tank was designed by The Preload Co. of New York.

FOR WATER TANKS OF DISTINCTION

CHOOSE *CONCRETE*

A well-designed concrete water tank such as this 2,000,000 gal. prestressed concrete water tank not only has long-lasting utility, but also unusual beauty. It is an outstanding landmark in the Casa View Heights section of Dallas, Texas.

Any city, large or small, can obtain lasting benefits by building such a reinforced concrete water tank. Its sturdy construction gives it the durability to withstand the weathering action of any climate. Its enduring beauty makes it a structure of which the entire community always can be proud.

A reinforced concrete water tank can be erected in practically any location without marring the skyline or depreciating the appearance or value of the property in the area.

Best of all, reinforced concrete water tanks are more economical than other types. They require little or no maintenance. They retain their distinctive appearance over their long life. And they render ***low-annual-cost*** service—the true measure of construction value. Such service pleases taxpayers, engineers and municipal officials alike.

PORTLAND CEMENT ASSOCIATION

33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

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but how about our most precious possession...water?

You'll save water—increase the system income—with Badger Meters

Forest conservation costs millions — and it's worth it. But the millions of *wasted gallons* of increasingly scarce water *could* cost the future of entire communities. Yet one basic step—replacing flat rates with Badger Meters — sharply reduces waste. Water revenue rises. And because they are Badger Meters, peak meter performance is assured for years.

Badger Meters have an unsurpassed record for low maintenance cost: ruggedly built of finest copper alloy. Control adjustment is simple. Working parts are few and standardized for easy, inexpensive replacement if ever needed.

By thus installing the finest meters available—Badger Meters—you put the department on an efficient, good-business basis, while saving vital water supplies through fair-share, fair-pay metering. Act now! Write for literature or to arrange a helpful consultation with a Badger Meter representative.

Outstanding disc, turbine and compound meters—⅝" through 12" —precision-engineered for lasting service.

Water is vital

Badger Meters have conserved it better for over 50 years.

Badger Water Meters

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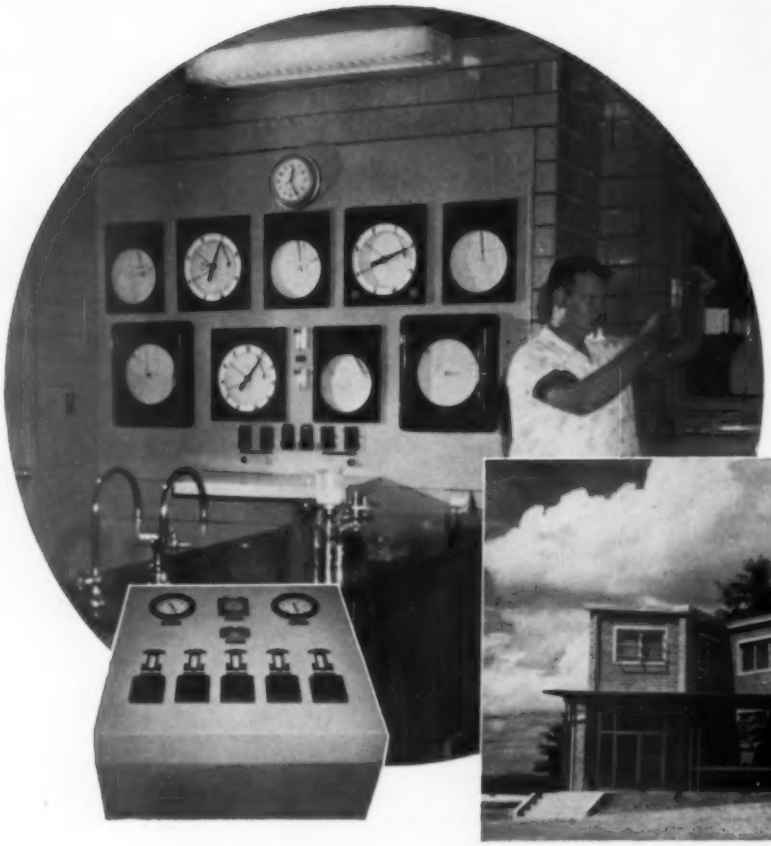


Valdese Filtration Plant (below), designed by W. K. Dickson & Co., built by Boyd and Goforth, Inc. Complete operating data for the plant is concentrated on a single Brown instrument panel, at left. Below at left is one of the consoles for controlling filter operation.

Honeywell engineered instrumentation automatically controls rapid sand filters

CONTROL of rapid sand filters, at the Valdese Water Filtration Plant, Valdese, N. C., is designed for maximum simplicity and convenience. From the central Brown instrument panel, operators have complete supervisory data on the entire operation . . . supplemented by individual console control of filtration rate and backwashing.

The Honeywell control system provides direct pneumatic operation of filter control valves, without need for the complexities of pneumatic-hydraulic relays. Valves 16" and larger can be opened or closed at the turn of a switch. Rate of filtration, too, is a single switch adjustment. Control is so designed that the plant automatically shuts down when levels in the reservoir and clear wells reach maximum limits.

This simplified system assures reduced costs for initial installation and for day-to-day operation of the plant. It provides maximum economy of treatment agents and water, through close correlation with laboratory testing. Pipe galleries stay clean and dry. And operators can supervise the functioning of the plant efficiently, without waste of time and power.

For the new water or waste treatment facilities you are planning, it will pay to have a Honeywell field man discuss Honeywell's field-proven new automatic filter control, with you and your consulting engineer. Call him today . . . he's as near to you as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS **Honeywell**

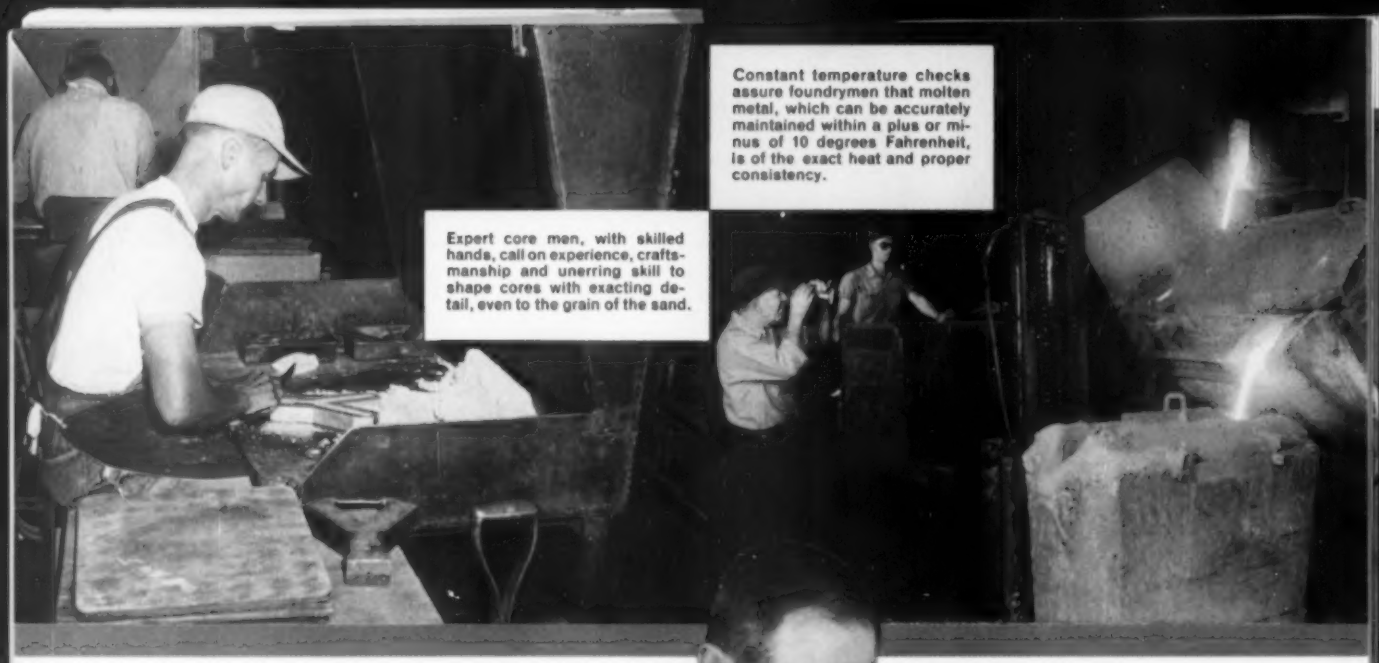
BROWN INSTRUMENTS

First in Controls

Craftsmanship...

TRADITION OF A CENTURY

Through a century of service, Mueller Co. has established a tradition of fine craftsmanship, with trained workmen utilizing lengthy experience and expert skills... and with exacting control of quality, materials and modern manufacturing methods...to produce superior, more dependable products for the nation's essential gas and water industries.



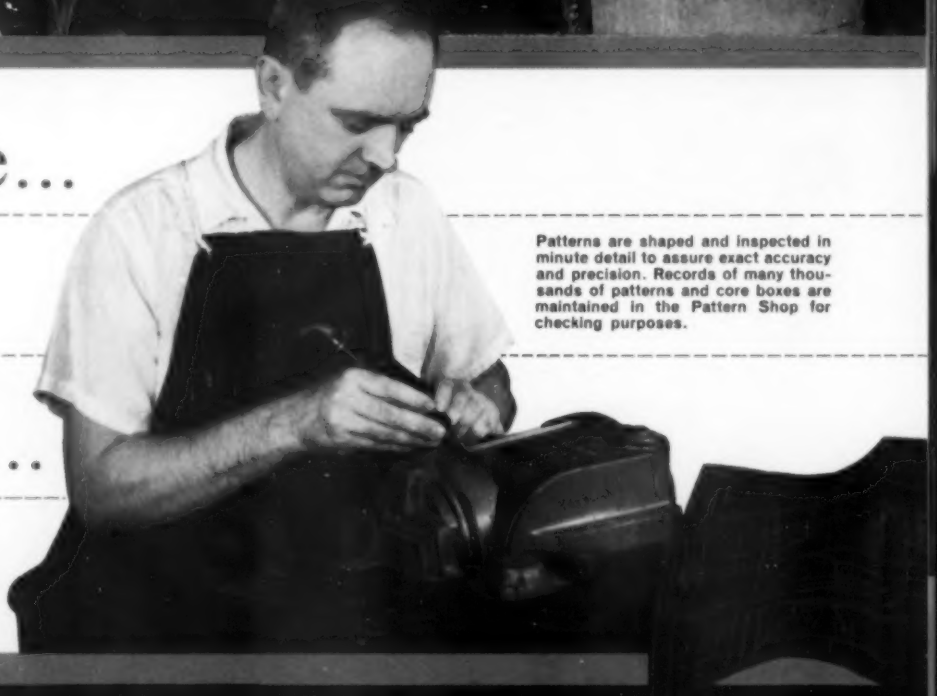
Constant temperature checks assure foundrymen that molten metal, which can be accurately maintained within a plus or minus of 10 degrees Fahrenheit, is of the exact heat and proper consistency.

Expert core men, with skilled hands, call on experience, craftsmanship and unerring skill to shape cores with exacting detail, even to the grain of the sand.

Patience...

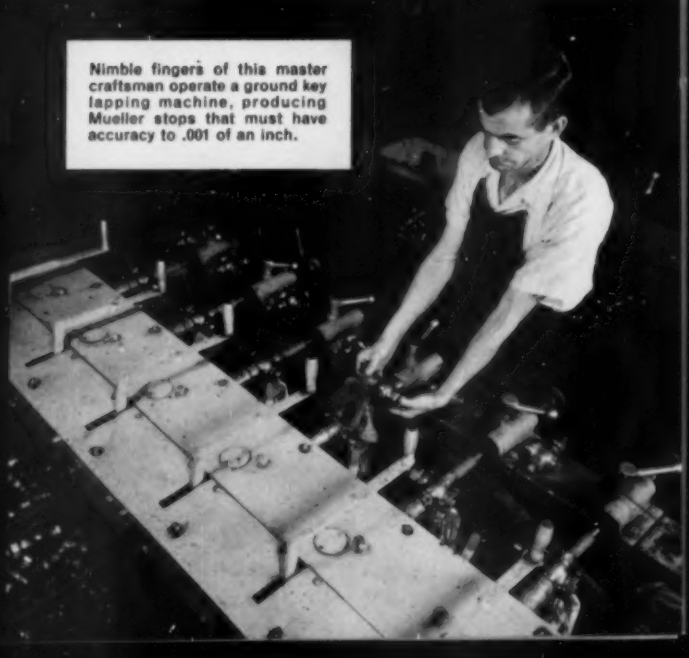
Pride...

Perfection...

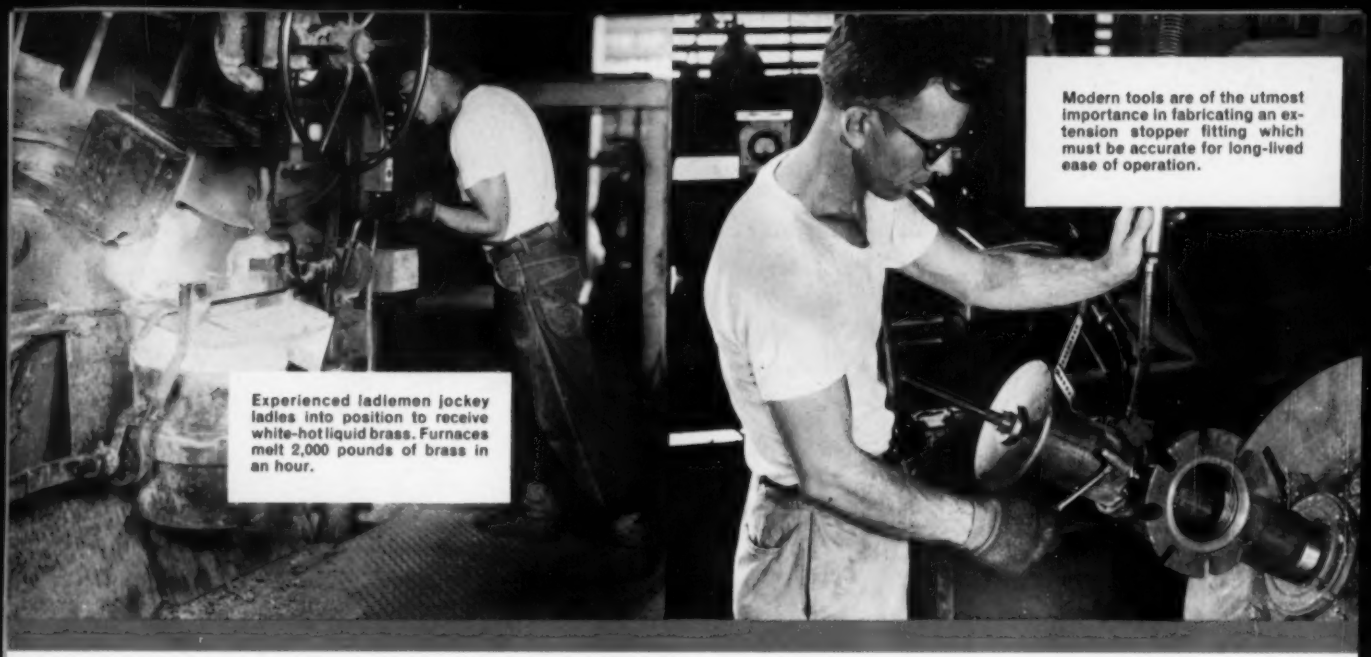


Patterns are shaped and inspected in minute detail to assure exact accuracy and precision. Records of many thousands of patterns and core boxes are maintained in the Pattern Shop for checking purposes.

Testing the alignment of plates used for making brass and iron castings. Accuracy to .001 of an inch is strictly maintained for perfect molds.



Nimble fingers of this master craftsman operate a ground key lapping machine, producing Mueller stops that must have accuracy to .001 of an inch.

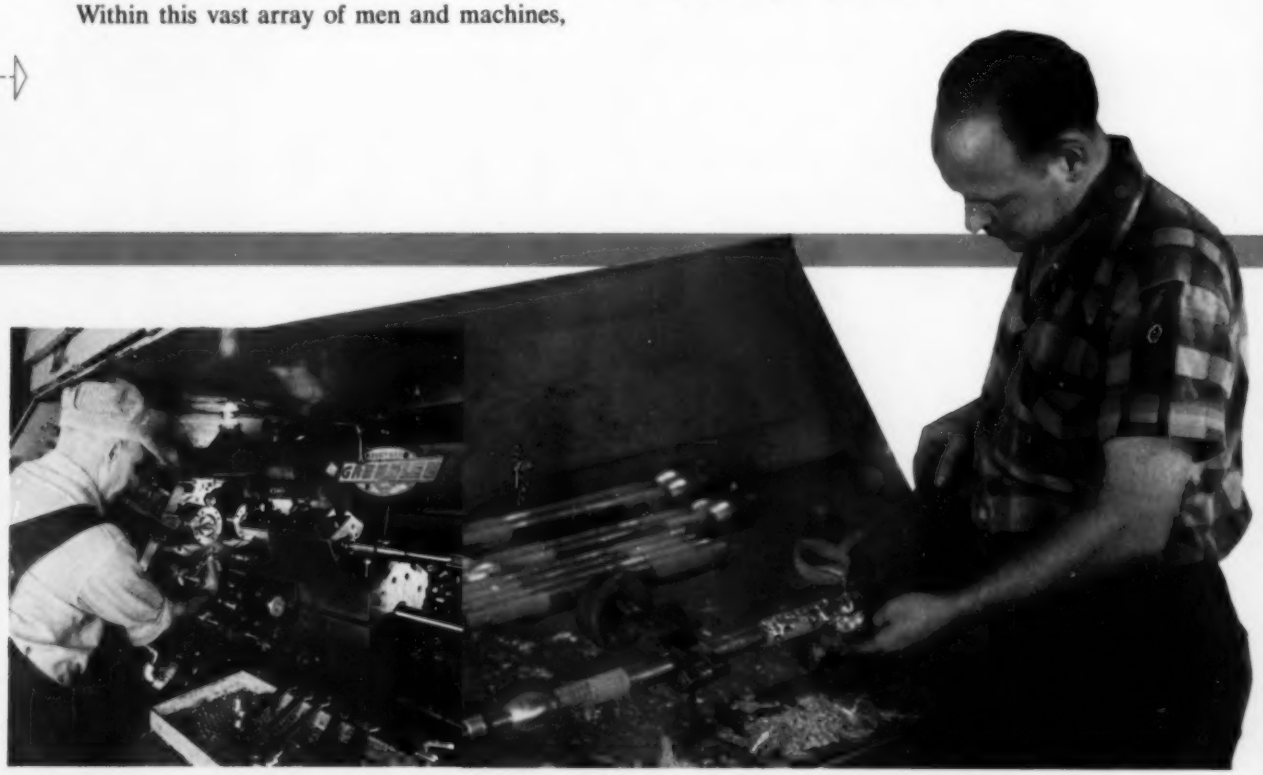


Experienced ladlemen jockey ladles into position to receive white-hot liquid brass. Furnaces melt 2,000 pounds of brass in an hour.

Modern tools are of the utmost importance in fabricating an extension stopper fitting which must be accurate for long-lived ease of operation.

Precision machines cutting gleaming metal to microscopic tolerances... turning conveyor lines carefully carrying partially completed products to assembly points... busy men of many talents adjusting instruments, reading gauges, skilfully performing their work—this is Mueller quality in the making!

Within this vast array of men and machines, every movement has a purpose... each and every man is thoroughly trained for his work, takes great pride in carrying it to perfection. Each part is carefully examined and tested to insure a product of highest quality and the finest workmanship possible... a product that will give long, safe and trouble-free service.



Never-ending patience and great pride in his work guide this machinist as he manufactures thousands of small parts used in Mueller products.

A skilled workman with a steady hand and a "fire-proof" thumb "wipes" a lead gooseneck joint to mirror-smooth perfection.

Working with extreme care, an experienced craftsman checks each component part of a drilling and tapping machine, insuring trouble-free service, efficient operation for many years.

Extensive testing of the Lub-O-Seal, under the scrutinizing eye of an engineering expert, gives the product a final approval. This Lub-O-Seal lost no efficiency after 1,000 high pressure tests.

Watchful eyes and precision machines combine to complete an exacting cut in a stem that will become an integral part of an ever-dependable Mueller Gate Valve.

Mueller fire hydrants are tested under high pressure to provide proof of the dependability of a product that must always be ready for instant service.

The final test . . .

When the finished unit leaves Mueller Co., the skill, the care and the quality built into each product must meet one final test . . . a test in which Mueller products have demonstrated superior quality time and time again.

This is the test of the product on the job . . . in the line to stay, giving dependable, efficient, long-lasting service . . . a test which proves that the century-old, Mueller tradition of craftsmanship is worthwhile.

MUELLER CO. **DECATUR, ILL.**

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In Canada: Mueller, Limited, Sarnia, Ontario

MUELLER CO. 100th YEAR SERVING the Water and Gas Industries QUALITY

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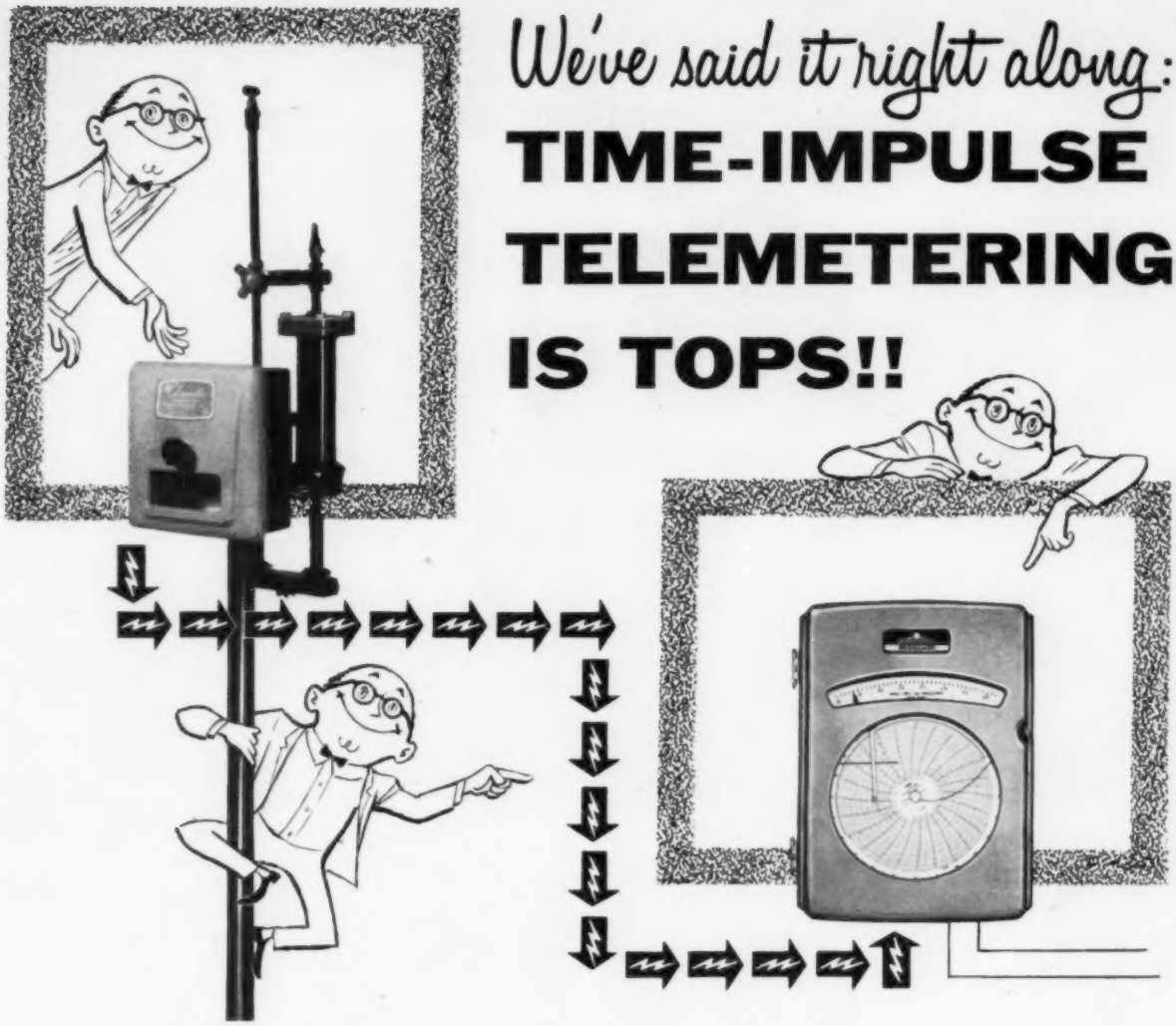

We've said it right along: TIME-IMPULSE TELEMETERING IS TOPS!!

. . . AND YOU'VE SAID IT TOO . . . WITH YOUR ORDERS!!

In Builders Chronoflo Telemetering Systems: The transmitting and receiving reactions depend only upon the *positively* controlled duration of regular electric circuit closures and *nothing* more. **The Telemeter** is a pure, *positive-action* positioning system.

- It *does not* have to *translate* units of electric measurement into terms of rate of flow or other factors measured.
- It requires *no* relatively delicate electric components.
- It *doesn't employ* a series of contact rods "shorted out" by step-by-step action of rising mercury.
- It is *not affected* by normally encountered induced voltages.
- Receiver *accuracy not affected* by room temperature, line pressure, duration of "down time", and similar factors.

The Chronoflo Receiver is *not* inferentially positioned except respect to time duration of the Transmitter signals.

These are *only a few* reasons why time-impulse telemetering is "Tops". Let the company which pioneered this system over 25 years ago and has the experience gained in engineering thousands of installations give you complete proof of its dependability and accuracy.

Request Bulletin 230-H4A. Write Builders-Providence, Inc., 350 Harris Ave., Providence 1, R. I.

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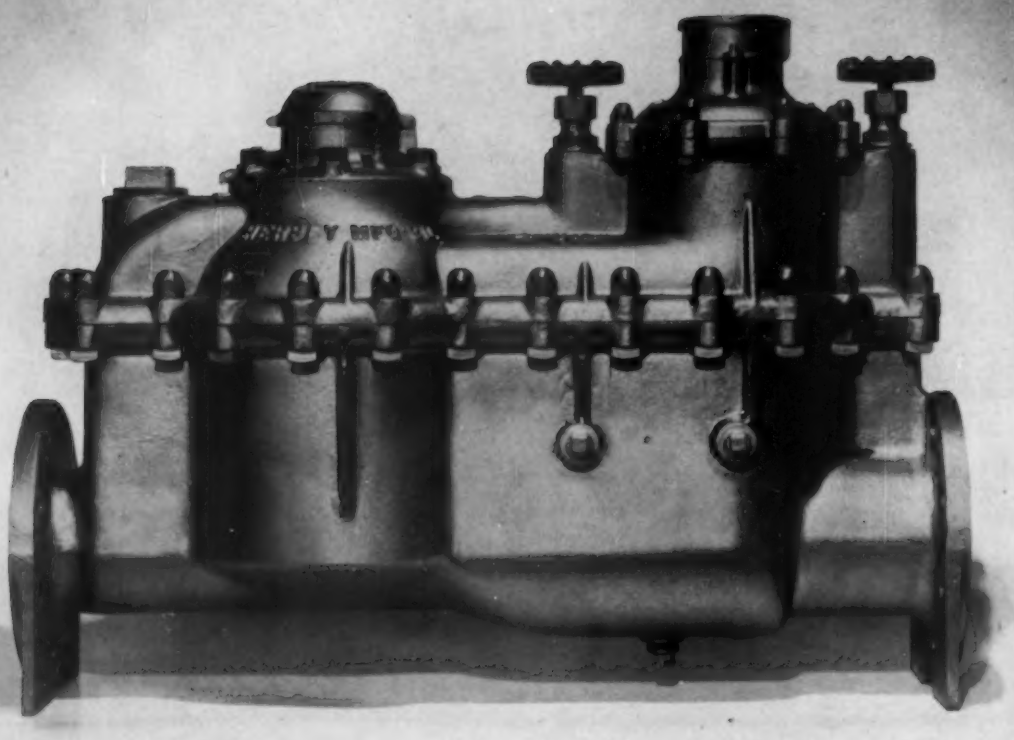

Unquestionably

HERSEY

COMPOUND METERS

are unequaled for the registration of all rates of flow. All Bronze Case, 2″ to 6″ inclusive.

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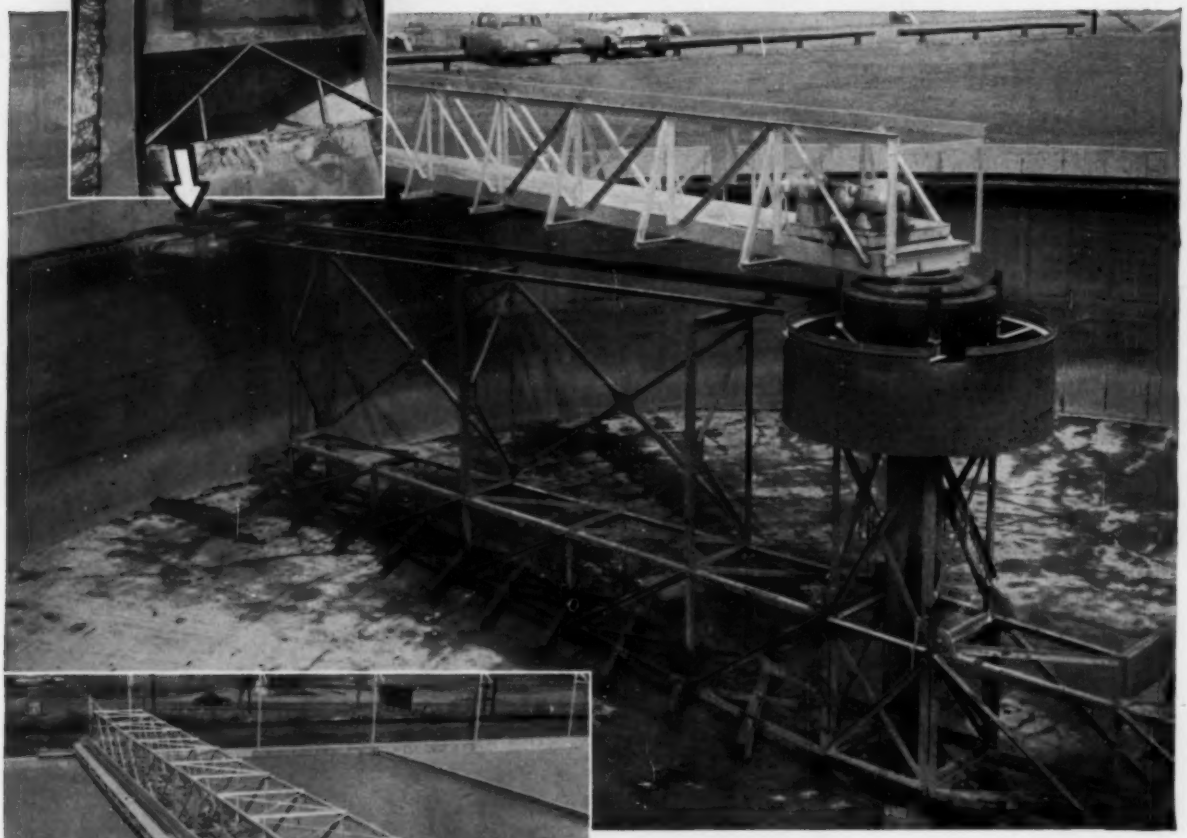
LINK-BELT equipment helps bring Manhattan, Kansas

low-cost sewage treatment

70-FT. LINK-BELT CIRCULINE Sludge Collector is fed raw sewage from bottom of tank. Specified by Wilson & Co., consultants, system features a superior automatic scum skimmer with rotating collection blade. Scum is worked into pocket by rotation. Passage of hinged blade on rotating arm (inset) deposits scum in box, eliminating all manual handling.



TRAVELING BELT CONVEYOR conveys dry sludge from 10 drying beds to trucks, thus reducing manual handling of sludge to a minimum. Push-button control station (circled) permits operator to move bridge automatically as removal progresses.

Circuline sludge collectors with automatic scum skimmers and traveling belt conveyor mechanize sludge collection and disposal

Like so many municipalities and industrial plants, the city of Manhattan uses Link-Belt Circuline Collectors for quick, low-cost sludge and scum removal. This integrated system incorporates a traveling belt conveyor and automatic scum skimmers—provides efficient, positive sludge removal . . . minimizes manual handling.

Link-Belt can apply a complete line of sanitary engineering equipment and extensive experience to your water, sewage or industrial waste treatment problems . . . will gladly work with your chemists and consultants. Call your nearby Link-Belt office.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,400

Superhighways

introduce problems of sanitation...

Jeffrey collectors in a settling tank in a treatment plant along the New York Thruway →

Jeffrey equipment is helping solve them

IT'S SMALLER in size, of course, to meet the demands of these thruway service areas. But the Jeffrey Sanitation Equipment employed has the same high degree of dependability as that used in hundreds of sewage, water and industrial waste treatment plants all over the world.

Jeffrey engineers' broad experience in the design and construction of sanitation systems covers all kinds of treatment needs. You can turn your treatment problems over to them with complete confidence. Jeffrey equipment can be depended upon to perform well and faithfully.

Catalog 905 describes Jeffrey Sanitation Equipment. For a copy, write The Jeffrey Manufacturing Company, 996 North Fourth Street, Columbus 16, Ohio.

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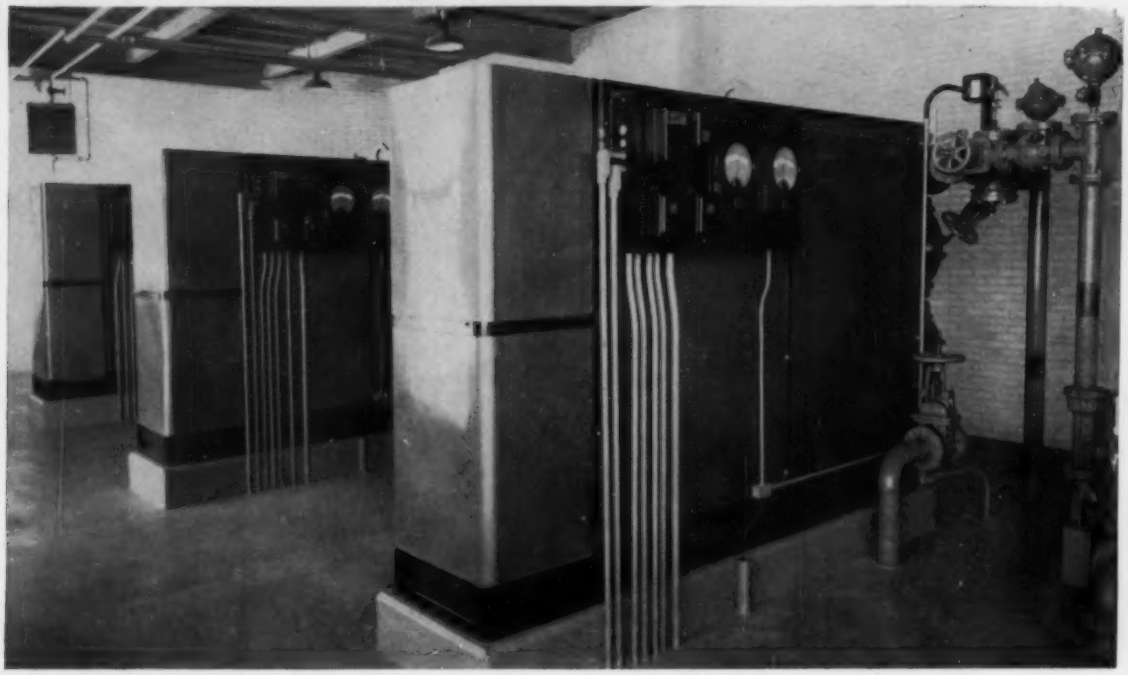
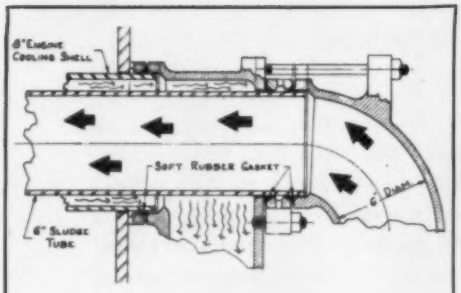
JEFFREY

Three P.F.T. Heater and Heat Exchanger units serve modern plant at York, Pa.



At York, Pennsylvania . . .

3 P.F.T. Digester Heat Exchangers installed for most efficient operation



POSITIVE SAFETY FROM CONTAMINATION

In these P.F.T. Exchangers, 6" interior tubes carry sludge, while 8" outer tubes carry heating water in the opposite direction (counterflow). Exclusive P.F.T. multiple-gasket joint design makes any leakage of sludge quickly detectable on the *outside* of the unit. This positively prevents contamination of water circulating in the 8" tubes, and safeguards the cooling system against costly clogging.

P.F.T. is the only manufacturer of both *shell and tube* type and *concentric tube* heat exchangers for sewage treatment. York thus could be sure of getting the best suited equipment for their sludge heating operation.

After careful analysis, three *P.F.T. #605 Heat Exchangers* of the concentric tube type were specified. Rated output is 1,000,000 B.t.u. per hour each. All parts are readily accessible. Return bends are easily removed for inspection and cleaning of both sludge and water tubes.

Digesters are economically heated by transferring waste heat from two 150 hp. gas engines to sludge recirculating through the #605 exchangers. *P.F.T. Gas Safety Equipment* protects the digesters and sludge gas system from flash-backs at the engines and boilers.

Design of plant by / *Albright and Friel, Incorporated Consulting Engineers Philadelphia, Pa.*

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

4241 Ravenswood Avenue
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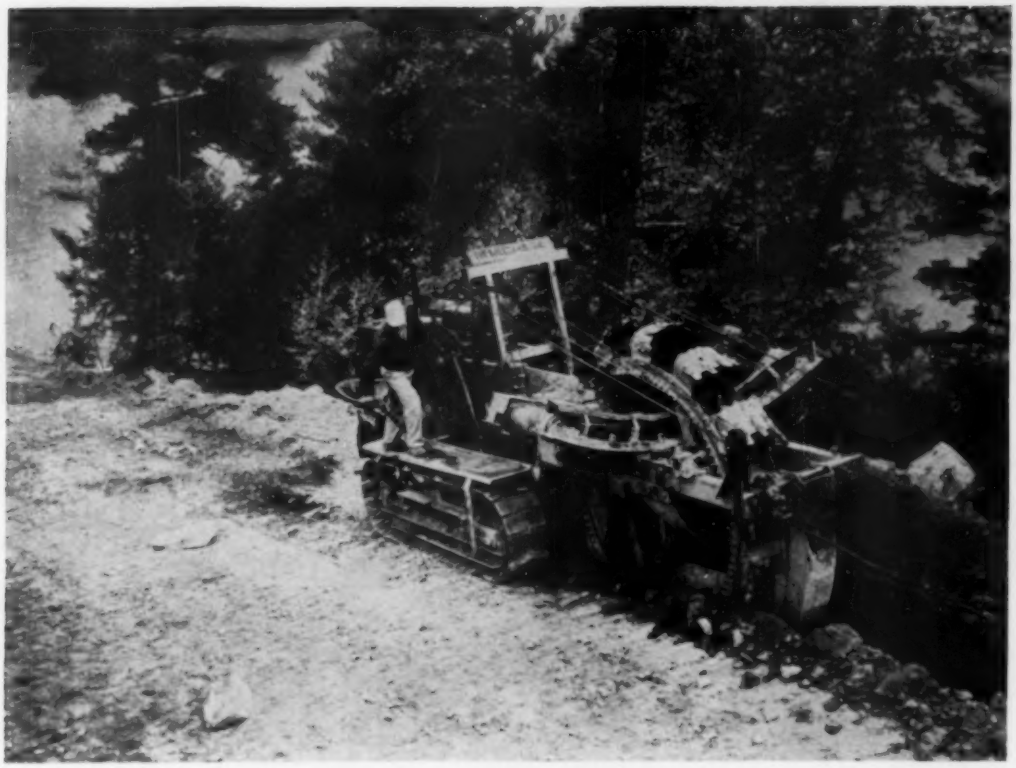

Cleveland 140 digs through rocky New Hampshire hills

"...exceeds wildest expectations"

"We got trench with our Clevelands where we thought it would be impossible," says H. J. Burns of Hallen Construction Co., Island Park, N. Y., about a recently completed pipeline job for the Granite State Transmission Co., between Exeter and Somersworth in the rugged New Hampshire hills. The Hallen spread cut through numerous swamps and terrain strewn with boulders and choked with frequent outcroppings of rock.

"Our Cleveland 140 cut 24 miles of our 30-mile section —dug everything except the deepest swamps and solid ledge rock. It dug through shale and even handled boulders up to 6 and 8 cubic feet. Even in the toughest going the 140 never fell below 1,700 feet of trench per day and averaged 2,200 feet per day for the whole job."

Good Everywhere

THE CLEVELAND TRENCHER COMPANY

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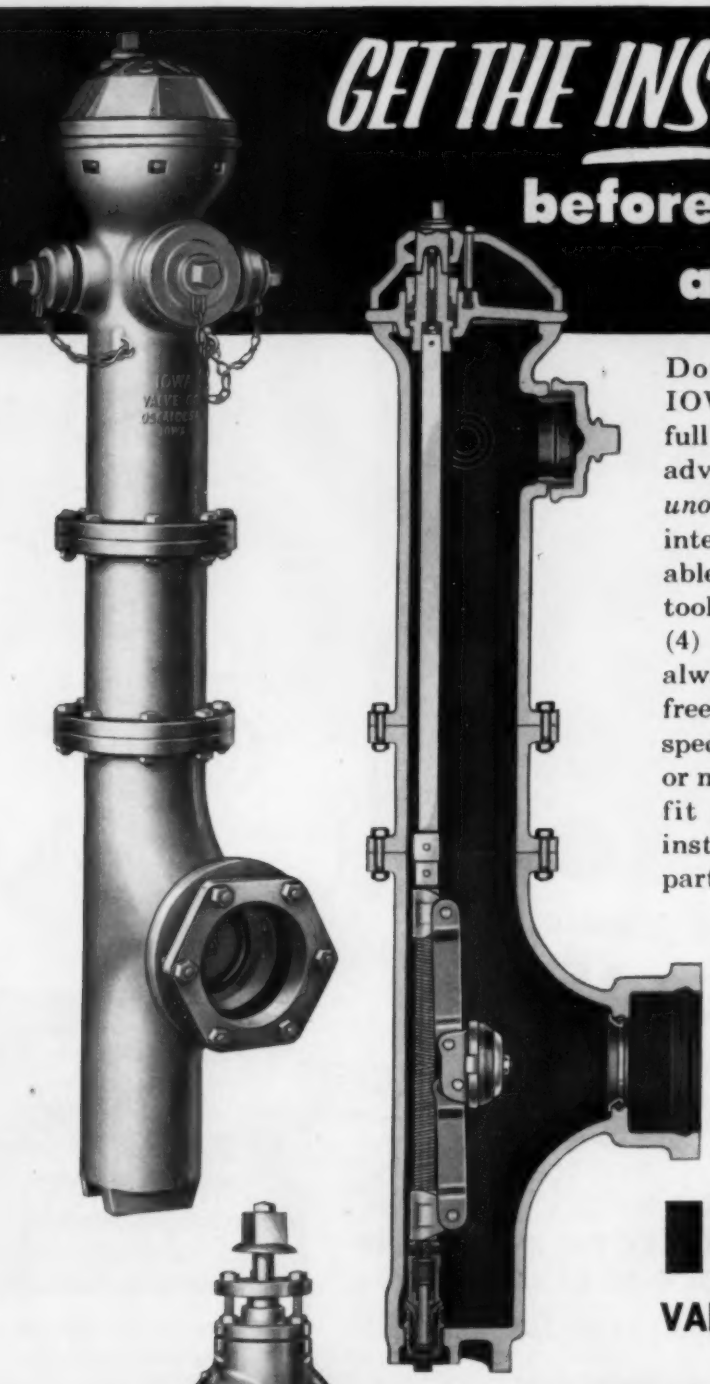
before you specify any hydrant!

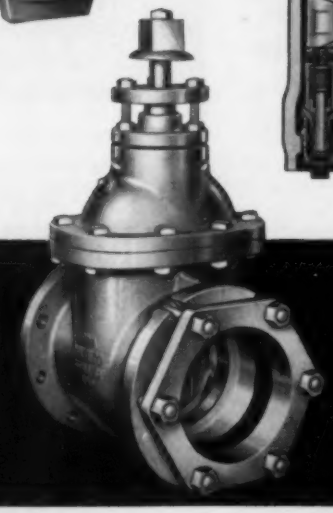


Don't buy blindly! Only in IOWA hydrants do you get full measure of such practical advantages as: (1) absolutely *unobstructed* waterway; (2) all internal working parts removable through top; (3) no special tools needed for maintenance; (4) no binding or distortion, always easily opened; (5) no freezing; (6) meet all A.W.W.A. specifications; (7) bell, flange or mechanical joint connections fit any existing or planned installation; (8) replacement parts always available.

that's why farsighted city officials choose

IOWA

VALVES AND HYDRANTS



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VALVE COMPANY

A Subsidiary of James B. Clow & Sons, Inc.

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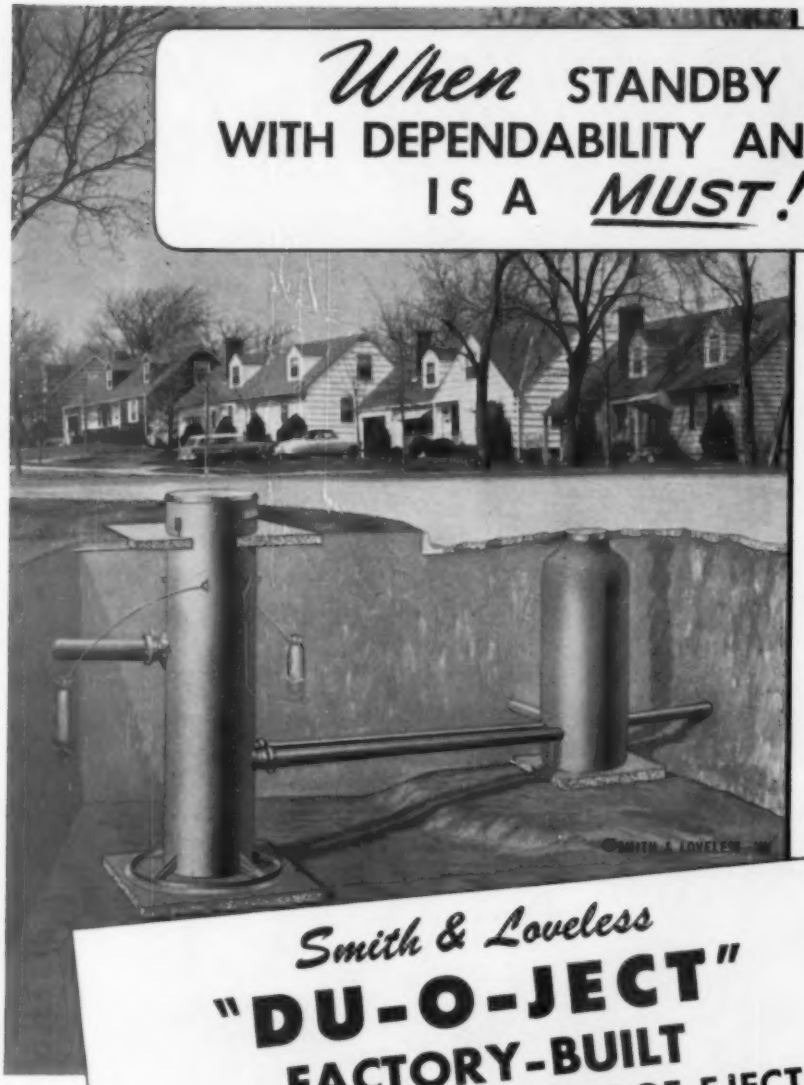
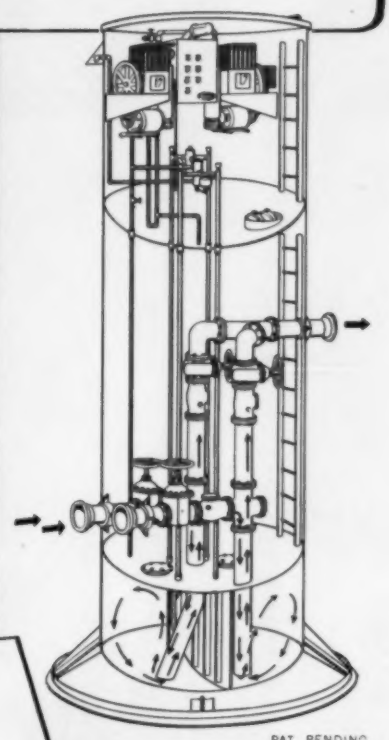
When STANDBY EQUIPMENT WITH DEPENDABILITY AND ECONOMY IS A *MUST!*





PAT PENDING

Smith & Loveless

"DU-O-JECT"

FACTORY-BUILT DUPLEX PNEUMATIC SEWAGE EJECTOR

FOR SUB-DIVISIONS
FACTORIES • MOTELS • SCHOOLS

NOW, YOU CAN HAVE DUPLEX EQUIPMENT AND PERFORMANCE AT FACTORY-BUILT LOW PRICES

- ★ BUILT OF THE FINEST MATERIALS BY FACTORY-TRAINED PERSONNEL
- ★ DESIGNED TO GIVE YOU THE UTMOST IN SERVICE AND DEPENDABILITY WITH FACTORY-BUILT SAVINGS
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DIAGRAM DRAWING SHOWS EFFICIENT, COMPLETE, COMPACT DESIGN OF THE *Smith & Loveless* "DU-O-JECT" ARROWS SHOW PATH OF MOVING SEWAGE

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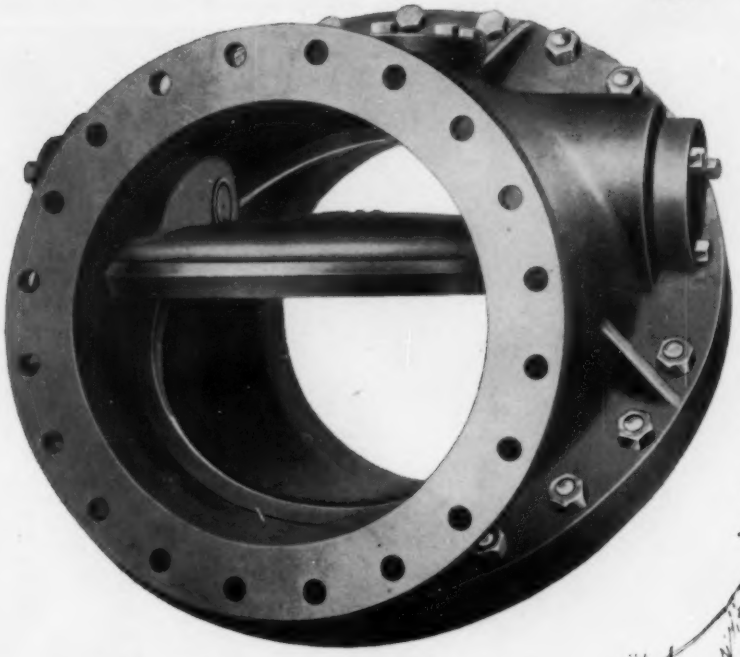
First with Floating Power



ALWAYS QUIET...ALWAYS QUICK

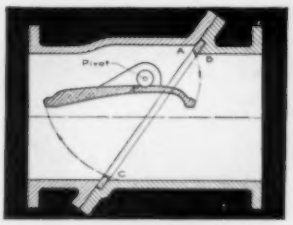
CHAPMAN

Tilting Disc Check Valve

You hear a lot about floating power these days. But Chapman Tilting Disc Check Valve has had it for quite some time. In fact Chapman was the first to have it . . . the first to have it in a valve . . . a feature that means much more to you in performance, much less to you in costs.

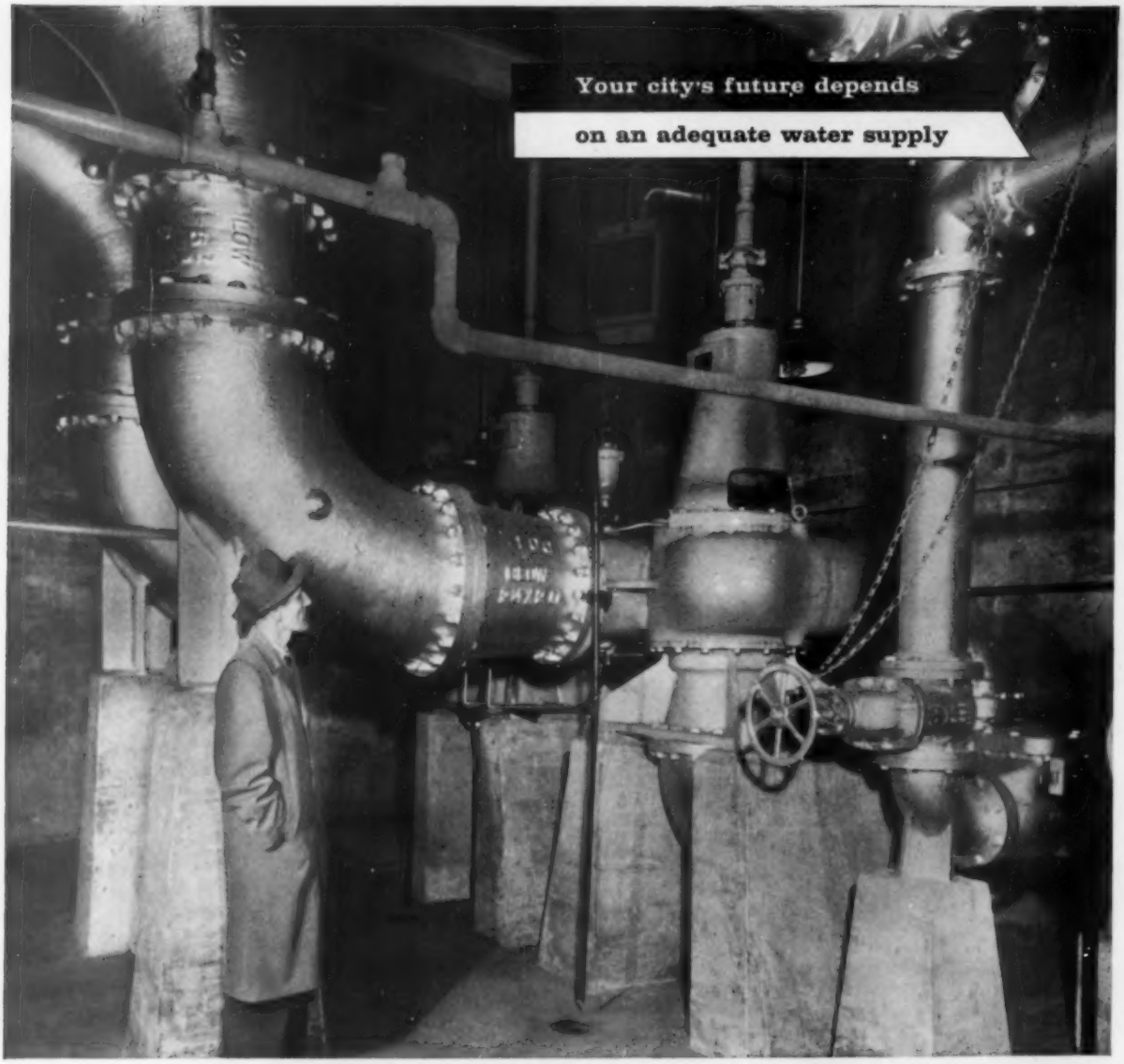
With Chapman's Tilting Disc Check Valve the "Airfoil" disc floats on the flow. When the flow is on, the disc balances perfectly . . . and quietly. There's never a flutter. No vibration. No trouble with head loss or flow resistance. And after the flow subsides the disc automatically drops to a closed position. The closing is fast. The closure is tight. No slamming. No banging. No damage to valve or system. No scraping or wearing of disc and seat. It all adds up to top performance and lowest maintenance and replacement costs even under severe operating conditions.

For handling fluids or gases under a wide range of pressures, always specify Chapman Tilting Disc Check Valves. They're available in iron or steel. Explained in full in our Catalog 30-A. Yours for the asking. Write.



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The CHAPMAN Valve
Manufacturing Co.
INDIAN ORCHARD, MASS.



Fairbanks-Morse 20" vertical "Angleflow" pumps at Hammond station.
Consulting Engineers: Bessozzi, Carpenter & Ignalzi, Hammond, Ind.

No more floods at Hammond

Until recently, a sudden rainstorm left Hammond, Indiana, in water up to its neck—with an overloaded drainage system flooding streets and basements.

Growth was the cause: growth of both population and industry.

Today, even a cloudburst is handled smoothly and automatically by Hammond's 9 new storm water disposal stations—with 21 Fairbanks-Morse motor-driven pumps discharging up to 195,500 gallons per minute.

Whether your problem is supply or drainage, municipal or industrial, see your Fairbanks-Morse Field Engineer. He'll be glad to work with your own engineer in planning low-cost, efficient expansion of your facilities.

Within the broad Fairbanks-Morse line, you'll find pumps of all types, all sizes for all magnitudes of water supply or disposal. For information, write Fairbanks, Morse & Co., Dept. WSW-6, 600 South Michigan Ave., Chicago 5, Ill.

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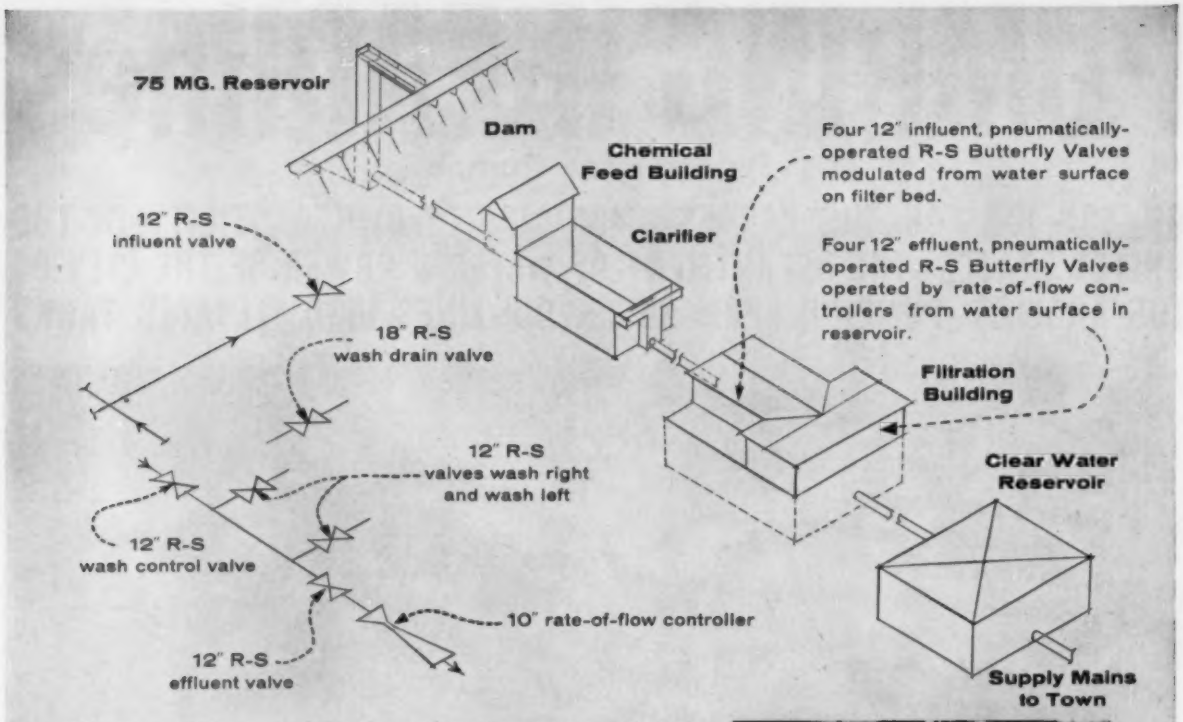
a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS


75 MG. Reservoir
Dam
Chemical Feed Building
Clarifier
Four 12" influent, pneumatically-operated R-S Butterfly Valves modulated from water surface on filter bed.
12" R-S influent valve
Four 12" effluent, pneumatically-operated R-S Butterfly Valves operated by rate-of-flow controllers from water surface in reservoir.
18" R-S wash drain valve
Filtration Building
12" R-S valves wash right and wash left
Clear Water Reservoir
12" R-S wash control valve
10" rate-of-flow controller
12" R-S effluent valve
Supply Mains to Town

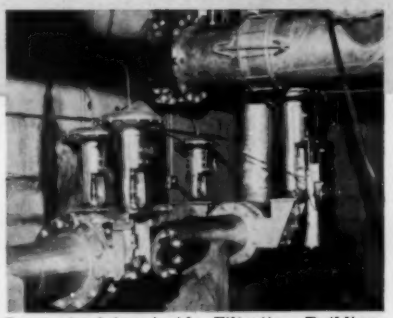
Diagrams of Durango Plant from sketches by Dale H. Rea, Consulting Engineer, Littleton, Colo., designer of the plant.

R-S Butterfly Valves used exclusively at Durango, Colorado,

TO GIVE CLOSE FLOW CONTROL

Durango, Colorado's 8.7 mgd water treatment plant operates automatically. But accurate flow control is necessary in this gravity system if the proper rate of flow in the treatment process is to be maintained. R-S Rubber-Seated Butterfly Valves were chosen to do this job. Their angle seating provides more desirable control characteristics. It means *more precise regulation over a greater range* than is available with 90° seated valves. 25 R-S Rubber-Seated Butterfly Valves, ranging from 12" to 18" in size, are installed here.

To obtain full information on the full SMS line – Butterfly Valves, Rotovalves and Ball Valves – contact our nearest representative or write S. Morgan Smith Company, York, Pennsylvania.



Compact piping inside Filtration Building shows rate-of-flow controller in left foreground, with wash and wash control valves behind it. This arrangement is diagrammed at left, above.

Two settling basins feed to Filtration Building in this 8.7 mgd system.

S. MORGAN SMITH HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

3

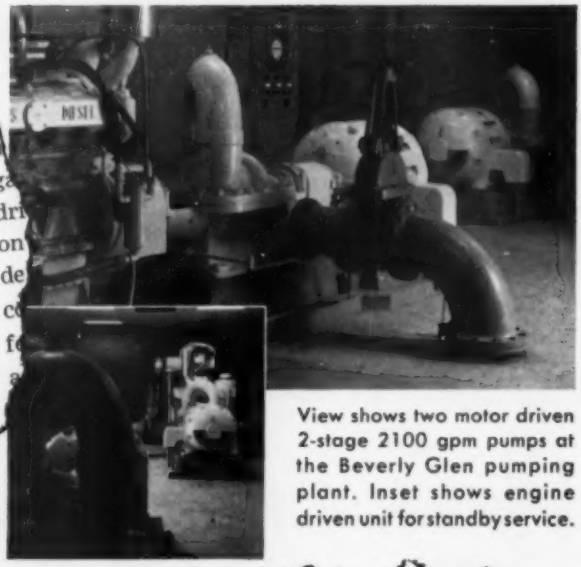
Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

PUMPING HEADlines

By Peerless Pumps

ON THE JOB FOR THE LARGEST MUNICIPALLY-OWNED UTILITY IN THE UNITED STATES—THE DEPARTMENT OF WATER & POWER OF THE CITY OF LOS ANGELES—PUMPING FROM RESERVOIR LINES INTO ELEVATED TANKS

510 FEET is the lift imposed on these 2-stage Peerless pumps. Two of the three 350 hp motor driven units can handle up to 6,000,000 gallons a day from inlet lines into an elevated storage tank of 2¼ million gallons capacity. The third unit, an engine driven pump, also rated at 350 hp, comes on in case of power failure and pressure demand. All three pumps are automatically controlled, starting and stopping being effected by pressure and flow controls. Pumps are designated as Peerless Type 8TU17.



View shows two motor driven 2-stage 2100 gpm pumps at the Beverly Glen pumping plant. Inset shows engine driven unit for standby service.

View shows outdoor all-weather installation of three motor driven 2-stage 1125 gpm pumps at Girard-Woodland pumping plant.

245 FEET is the head on these three Peerless 2-stage Type 5TU15 pumps. Like the units above, these pumps also handle water from a reservoir inlet line, lifting it into an elevated tank, in this case of 1 million gallon capacity. The three pumps have a capacity of up to 3,000,000 gallons a day.

For dependable, efficient pumping select and install versatile Peerless horizontal centrifugal pumps.

Mail the coupon below for illustrated and descriptive Bulletin.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
301 WEST AVENUE 26, LOS ANGELES 31, CALIFORNIA

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Factories: Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York; Atlanta; Chicago; St. Louis; Phoenix; San Francisco; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque.
Distributors in Principal Cities.
Consult your Telephone Directory.

☐ *Please send me Peerless Pump Bulletin No. B-1400*

NAME _____ COMPANY _____

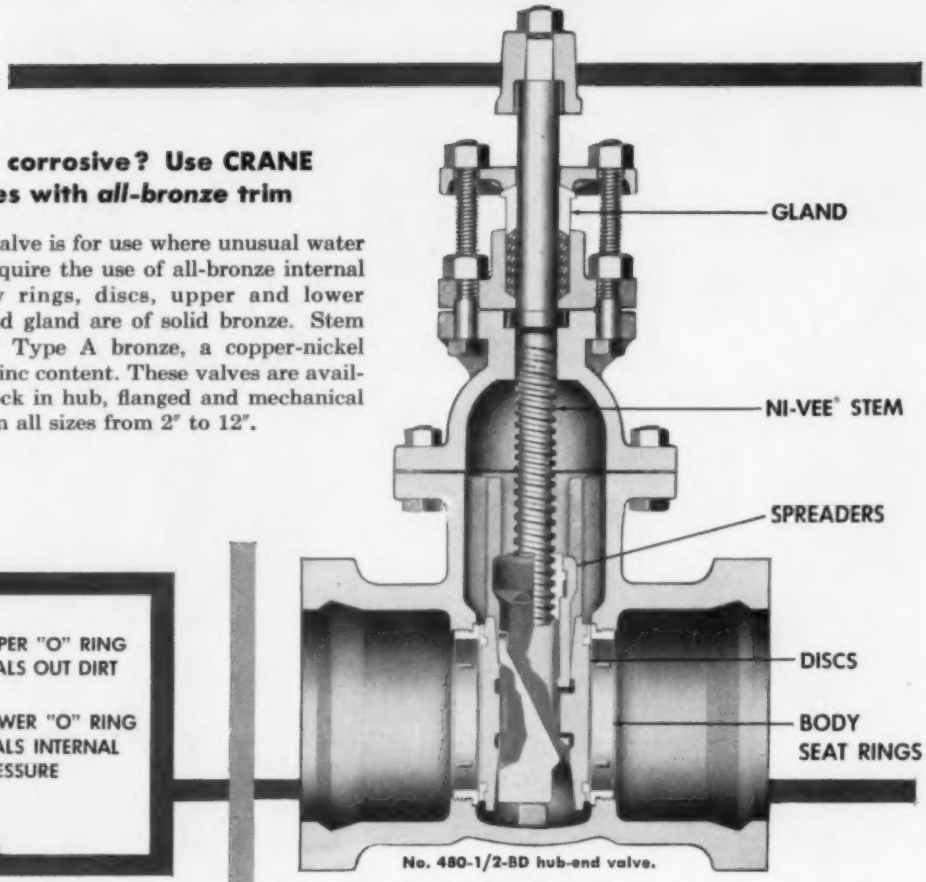
ADDRESS _____ CITY _____ STATE _____

WSW

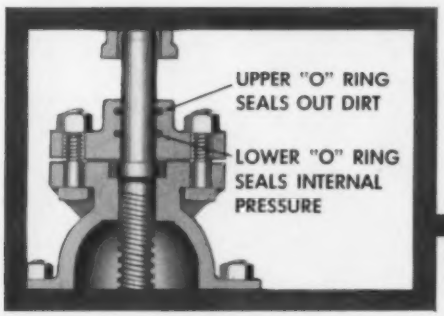
CRANE expands A.W.W.A. line for special needs

Water corrosive? Use CRANE valves with *all-bronze* trim

This Crane valve is for use where unusual water conditions require the use of all-bronze internal parts. Body rings, discs, upper and lower spreaders, and gland are of solid bronze. Stem is "Ni-Vee"* Type A bronze, a copper-nickel alloy of low zinc content. These valves are available from stock in hub, flanged and mechanical joint ends—in all sizes from 2″ to 12″.



No. 480-1/2-BD hub-end valve.



Double "O" ring stuffing box now available

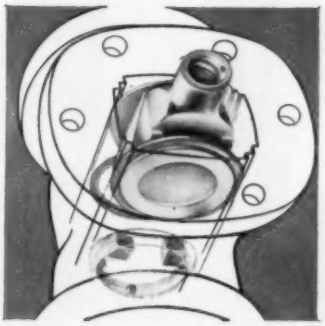
Another feature now available in Crane A.W.W.A. non-rising stem valves is an "O" ring stuffing box. Two Buna-N "O" ring seals hug the stem tightly. Lower ring acts to seal the internal pressure; upper ring is an external dirt seal and reserve pressure seal. Valves with "O" ring stuffing boxes are available with hub, flanged, mechanical joint ends—in all sizes from 2″ to 12″.

*"Ni-Vee" is the registered trade-mark of International Nickel Co.

Features of CRANE A.W.W.A. Valves justify their choice

Simple, 4-part double-disc assembly—2 discs, 2 spreaders. Discs are free to rotate—minimizing concentrated seat wear. Discs cannot fall out or jam. Easy opening and tight closing assured. Valves have much longer service life.

For complete details on these valves, write for circular AD-2108.



CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

the pump they couldn't clog!

It was a hydropulper application, handling 500 GPM of 5% stock at 50′ TDH. Among the things that sometimes entered the line were rubber gloves, baling wire, and even a tablecloth! A 6″ Wemco torque flow Solids Pump passed them all and asked for more!

Write for more information on this amazing pump and its "can't-clog" *liquid impeller action.*

WEMCO TORQUE-FLOW

SOLIDS PUMP

WESTERN MACHINERY COMPANY
650 FIFTH STREET
SAN FRANCISCO 7, CALIFORNIA

Improve your safety program with the new Hooker chlorine wall chart

Since chlorine is as safe as the people who handle it, you can help ward off accidents by instructing your employees on safe handling methods.

In concise, easy-to-understand terms, the new Hooker chlorine wall chart lists some precautions to be observed in handling tank cars, cylinders, and ton containers of chlorine.

It tells some of the things to do and, equally important, some of the things not to do, with chlorine.

It contains sections on first aid and emergency methods—advice that can minimize the effects of an accident should it occur.

Mail the coupon for a copy of this chart today. The wall chart supplements in easy-to-post form more complete and detailed engineering and safety information found in the 76-page book, "Hooker Chlorine."

HOOKER CHEMICALS PLASTICS

HOOKER ELECTROCHEMICAL COMPANY
1706 UNION STREET, NIAGARA FALLS, N. Y.

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Please send me a copy of the Chlorine Safety Chart.

Name.....

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Transite Pressure Pipe assures dependable service through the years

ENGINEERS and city officials face much the same problem in pipe selection. It is twofold: (1) How to make sure the community gets many long years of trouble-free performance from its pressure mains, and (2) How to do this as economically as possible by choosing pipe for durability plus savings.

Transite® Pressure Pipe is solving this problem in hundreds of municipalities and water districts from coast to coast. Here's why. An asbestos-cement product, strong and durable and highly resistant to corrosion, it has effected economies in installation as well as operation.

For example, the community benefits even at the very outset, since both handling and assembly of Transite Pressure Pipe are so simple that crews can install as fast as trench is opened. This means lower installed costs.

Another Transite Pipe characteristic instantly recognized by engineers as of major importance is its smooth interior that stays smooth. This provides maintained high flow capacity. (Flow coefficient is C-140.)

, , ,

For further information about Transite Pressure Pipe with the Ring-Tite® Coupling, write for Booklet TR-160A. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

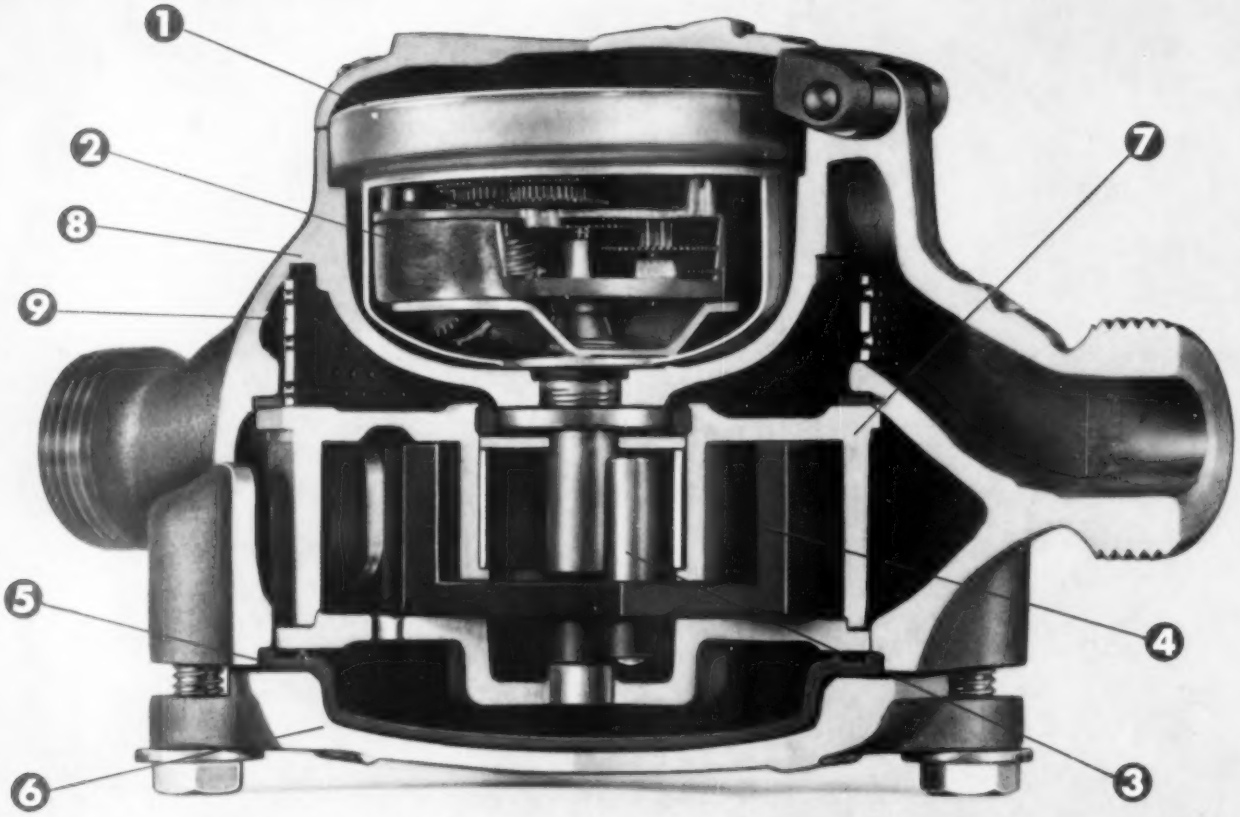
JM PRODUCT

Johns-Manville TRANSITE PRESSURE PIPE
WITH THE RING-TITE® COUPLING

The WATER METER OF THE FUTURE Is Here TODAY!

Rockwell Announces

The Most Important Advance In Water Meter History



ROCKWELL SEALED REGISTER WATER METER **with Powerful Magnetic Drive**

Presenting

THE INSIDE STORY OF A REVOLUTIONARY METER DESIGN HAVING ALL THE FEATURES YOU ASKED FOR

1. HEAT TREATED GLASS —stops breakage.
2. HERMETICALLY SEALED REGISTER —to prevent condensation—to keep out water and dirt.
3. MAGNETIC DRIVE —eliminates stuffing box—reduces drag on measuring chamber.
4. OSCILLATING PISTON —time proven for accuracy and durability.
5. "O"-RING GASKET —molded into bottom plate liner—provides positive seal.
6. INTERCHANGEABLE BOTTOM PLATE —bronze or cast iron (for frost protection).
7. MEASURING CHAMBER —mates without screws.
8. CAST BRONZE CASE —with full flow passageways.
9. CYLINDRICAL STRAINER —large area for unrestricted flow.

Quick Facts about the ROCKWELL SEALED REGISTER WATER METER

It's an entirely new water meter, designed and constructed in answer to the expressed needs of the water works industry for better measurement at lower cost.

The principal features are (1) an hermetically sealed register to end forever the problem of dirt, water and condensation that fogs dials, (2) a powerful magnetic drive which eliminates the need for a stuffing box, an exposed intermediate train and a driving dog, (3) the proven oscillating piston principle for a long life of accurate measurement.

This all-new design is cased in an attractive housing that's more compact, easier to handle and install.

FIVE POINTS OF SUPERIORITY

1. GREATER ACCURACY

Straighter line curve—picks up smallest leaks.
No friction from conventional driving dog, gear train, stuffing box and register.
Oscillating piston principle for proven accuracy, sustained long life.

2. ALWAYS EASY TO READ

No fogging, no dirt, no oil, no fading of dials.
Larger dial.
Fewer misreads and bill corrections.
Home-owner can read—fewer complaints.

3. LOWEST MAINTENANCE

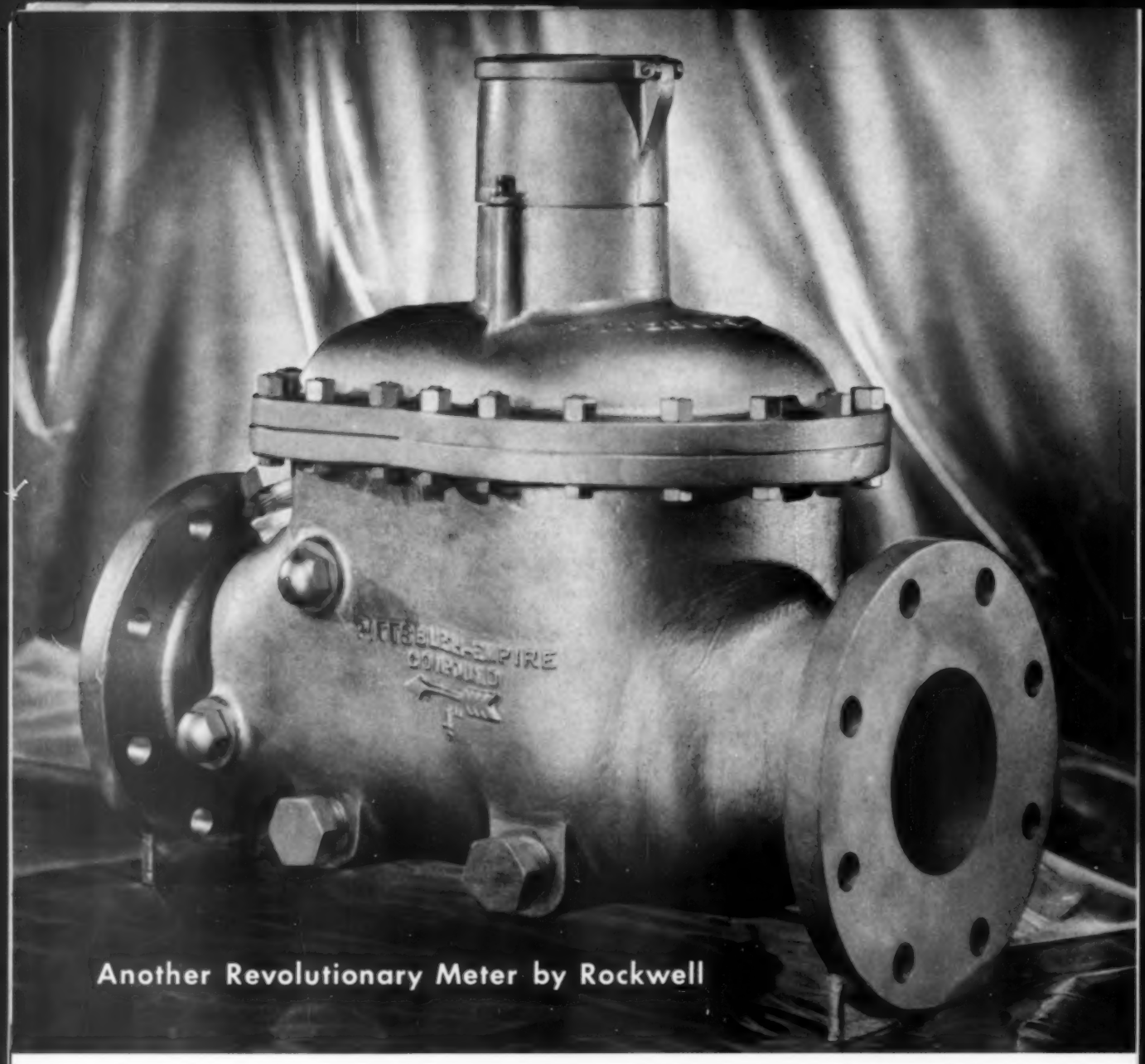
Simple tools needed to repair and little training needed.
Only two things to clean, measuring chamber and piston—no fitting of parts required.
One-half labor expense per meter.
No register to repair—no gear train to repair.
No stuffing box spindle, no driving dogs to replace.

4. NO STUFFING BOX LEAKS

No service required.
No expensive crew needed for this purpose.
No messy yard or basements—no customer complaints.
No register damage.

5. TAMPER PROOF

Register is inaccessible—no seal screws required.
Magnets are shielded.
Impractical to run back even with measuring chamber removed.



ALL THESE ADVANTAGES IN THE ROCKWELL SINGLE REGISTER COMPOUND METER

READS DIRECT TO AVOID ERRORS
The single register eliminates errors in reading and adding together the records from two registers.

LIGHTEST—MOST COMPACT
Size for size this meter is much more compact and lighter in weight than other compounds.

LOWEST PRESSURE LOSS
Horizontally mounted propeller with swing action compounding valve permits large volumes to flow in a straight-through path with lowest pressure absorption.

MANIFOLDING AVAILABLE
Two 4-inch Rockwell compounds furnished with complete manifold piping and valves will do a better job of measurement than a single 8-inch compound. This assembly is lighter, easier to install and simplifies maintenance since one side of the manifold can be shut down without interrupting service.

TURNS BOTH TRICKLES AND TORRENTS INTO DOLLARS
Small flows which ordinary compounds don't register are caught and accurately measured by this exclusive design. There is no detectable changeover point—no lost registration that reaches up to 15 per cent in conventional meters.

ROCKWELL MANUFACTURING COMPANY

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In Canada: Rockwell Manufacturing Company of Canada, Ltd., Toronto, Ontario

ROCKWELL

HOW TO SAVE MONEY ON POWER OPERATED VALVES

More and more water and waste plants are streamlining operations with power operated valves for remote or automatic operation. And in most of these plants, Rockwell-Nordstrom lubricated plug valves are a part of the *closed specifications*. Here's why:

SIMPLER, LESS COSTLY OPERATORS: Quarter-turn, lubricant-smooth operation means less torque and shorter movement for *full* opening or closure. No extra heavy force needed to wedge or free seats.

LOWER MAINTENANCE: The pressurized lubricant that assures positive leakproof shut-off also prevents metal-to-metal friction wear for longer valve life at lower cost.

INSTANT OPERATION: The *tapered* plug seats perfectly on a "cushion" of pressurized lubricant . . . stuck valves can't cause costly or hazardous flow control errors.

Rockwell-Nordstrom valves are available in a full range of sizes and pressure ratings for electric, pneumatic and cylinder operation.

Write for complete details: Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed for Positive Shut-Off

Rockwell Manufacturing Co.
Pittsburgh 8, Pennsylvania

☐ Please send me Bulletin C-5200.
☐ Please have your sales engineer call.

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Address_____

City_____ Zone_____ State_____

burning water...

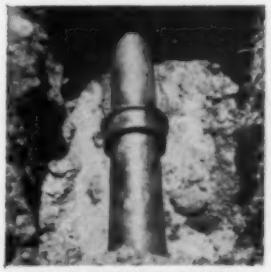
A carelessly flicked match or cigarette....

A forest dies. Water, no longer absorbed by the sunbaked soil, runs off... carries with it irreplaceable topsoil. Another natural watershed... life and health for thousands... is lost. Sometimes, for centuries!

You can help stop this criminal waste of God-given resources. In the woods, be careful of matches and campfires. As for water:

1. Encourage future planning of water facilities.
2. Support realistic water rates and water supply bond issues.
3. Conserve water wherever you can.

"Plentiful as water" no longer applies to America.



STILL GOING STRONG!

This 8" cast iron water main laid in Williamsport, Pennsylvania in 1855. Carrying water from the city's reservoir to its distribution system, it has been in continuous use for 102 years and is still in excellent condition.

Performance like this is another of the many reasons forward-looking water officials specify cast iron pipe. It's America's Number One Tax Saver... and the record proves it!

CAST IRON PIPE
RESEARCH ASSOCIATION — SUITE 3440, PRUDENTIAL PLAZA, CHICAGO 1, ILL.

MODERNIZED **cast iron**

WATER...

IS EVERYONE'S BUSINESS!

The sooner Americans realize the gravity of our water problem the better it will be for them . . . and for you.

No easy job convincing *your* community it can no longer take water for granted. But advertisements* like the one opposite help you.

Not only do they warn of the growing seriousness of our water problem; they tell Americans what to do about it.

This means more support, sympathy and cooperation for *your* program . . . big or small as it may be.

CAST IRON

Cast Iron Pipe Research Association, Thos. F. Wolfe,
Managing Director, Suite 3440, Prudential Plaza, Chicago 1, Ill.

* *Appearing in:* Nation's Business, Newsweek,
Saturday Evening Post, U. S. News & World Report.

pipe FOR MODERN WATER WORKS

8 CLIMAX

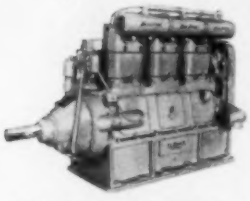
Engines For Water Works Standby and Peak Load Power...Up to 610 H.P.

Climax engines have proved their dependability to consulting engineers, plant superintendents and city officials for well over 20 years.

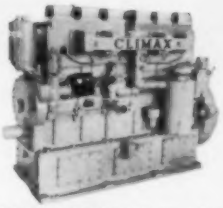
They know that when normal utility power is interrupted... motor power fails... or peak loads are encountered... plenty of standby power is on hand to take over for as long as necessary.

Each of the engines illustrated is capable of operation on natural gas, butane, gasoline or a combination of any two of these fuels. Accessories suited to individual applications are available.

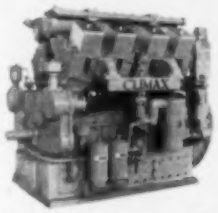
Write direct for complete information, bulletins or engineering consultation.



R-110—4 cylinder, 130 max. hp. at 1200 rpm.
R-165—6 cylinder, 194 max. hp. at 1200 rpm.
Ask for Bulletin SA-609



K-67—6 cylinder, 265 max. hp. at 1200 rpm.
K-75—6 cylinder, 305 max. hp. at 1200 rpm.
Ask for Bulletin SA-610



V-80—8 cylinder, 340 max. hp. at 1200 rpm.
V-85—8 cylinder, 390 max. hp. at 1200 rpm.
Ask for Bulletin SA-584-B

V-122—12 cylinder, 520 max. hp. at 1200 rpm.
V-125—12 cylinder, 610 max. hp. at 1200 rpm.
Ask for Bulletin SA-542-C

Important Features:

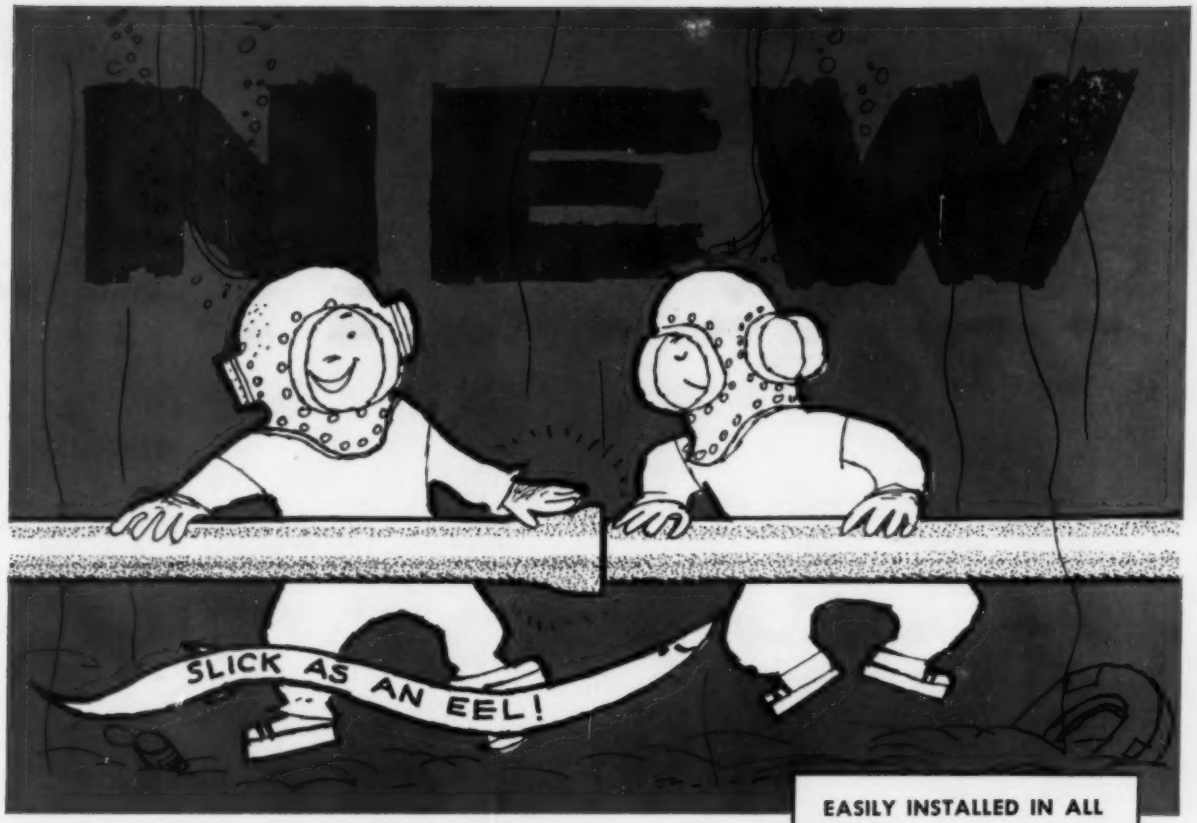
- **Instant, easy starting—smooth operating.**
- **High mechanical efficiency for years of trouble-free service.**
- **Operation over wide speed range without encountering criticals.**
- **Easy maintenance.**

CLIMAX

ENGINE MANUFACTURING COMPANY

208 A S. La Salle St. • Chicago 4, Illinois

Factory—Clinton, Iowa *District Office*—Dallas, Texas



EASILY INSTALLED IN ALL KINDS OF WEATHER . . . YOU COULD EVEN DO IT UNDER WATER!

CLOW

SLIP-ON PIPE JOINT*

forms bottle-tight joint instantly!

Saves you so much time you'll think the clock is paralyzed. Yet assembly is simple and easy, and you get a seal that's tight as a drum. Best of all, you get Clow Cast Iron Pipe . . . for the watermain installation that is economical and permanent.

Want more details? You should have them. There's a Clow man not too far from you right now . . . ready to give you all the facts. Phone us—or drop us a note.

**Patent applied for*

EASY AS "A-B-C"!

A INSERT GASKET IN BELL.

B WIPE ON LUBRICANT.

C SLIP PLAIN END INTO BELL.

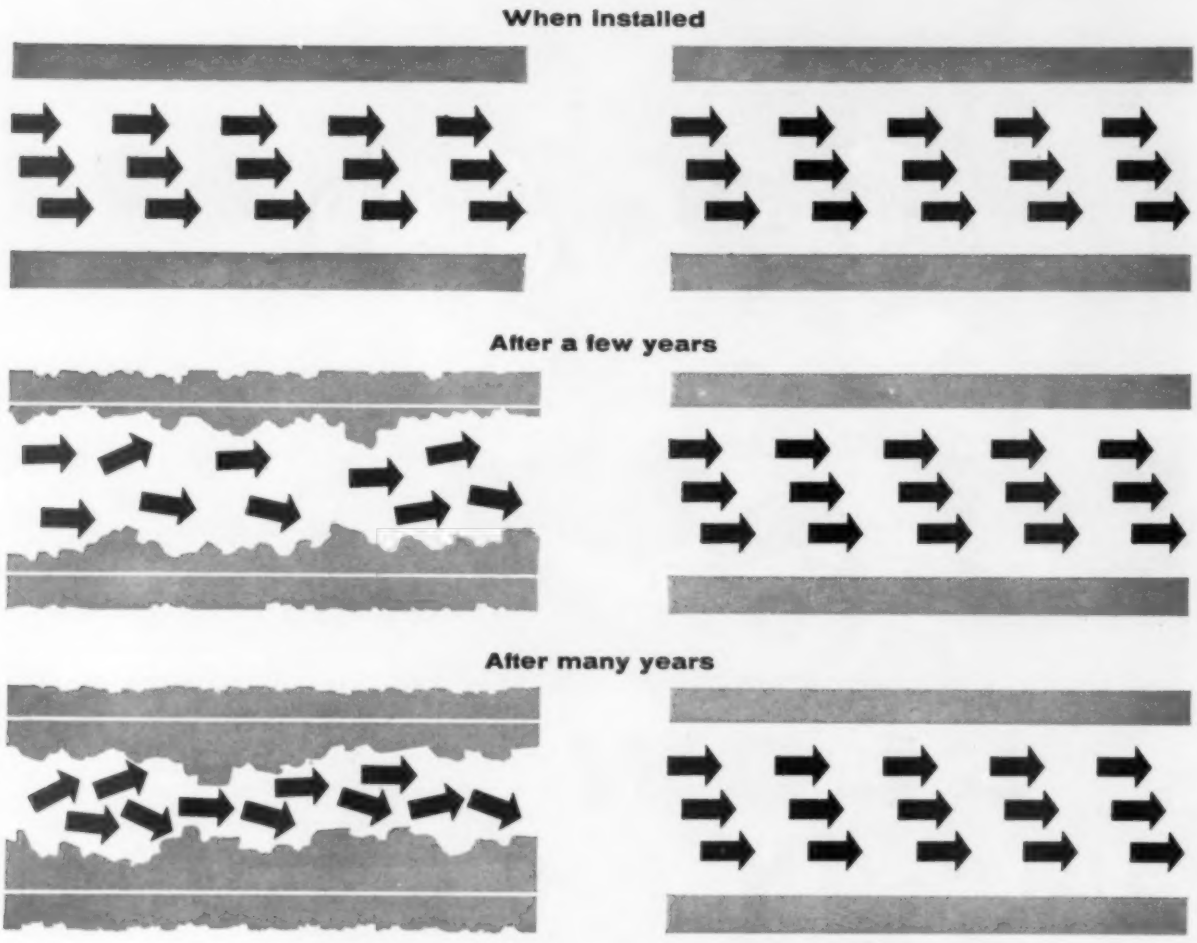
SINCE 1878

JAMES B. CLOW & SONS, Inc.

201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries:
Eddy Valve Company, Waterford, New York
Iowa Valve Company, Oskaloosa, Iowa

OLD-FASHIONED PIPE K&M ASBESTOS PIPE



Choose your pipe for keeps

Installing K&M Asbestos-Cement Pipe is a fast, easy, permanent job with the exclusive K&M "Fluid-Tite" Coupling. No heavy equipment or skilled labor needed, no waiting for favorable weather or ground conditions.

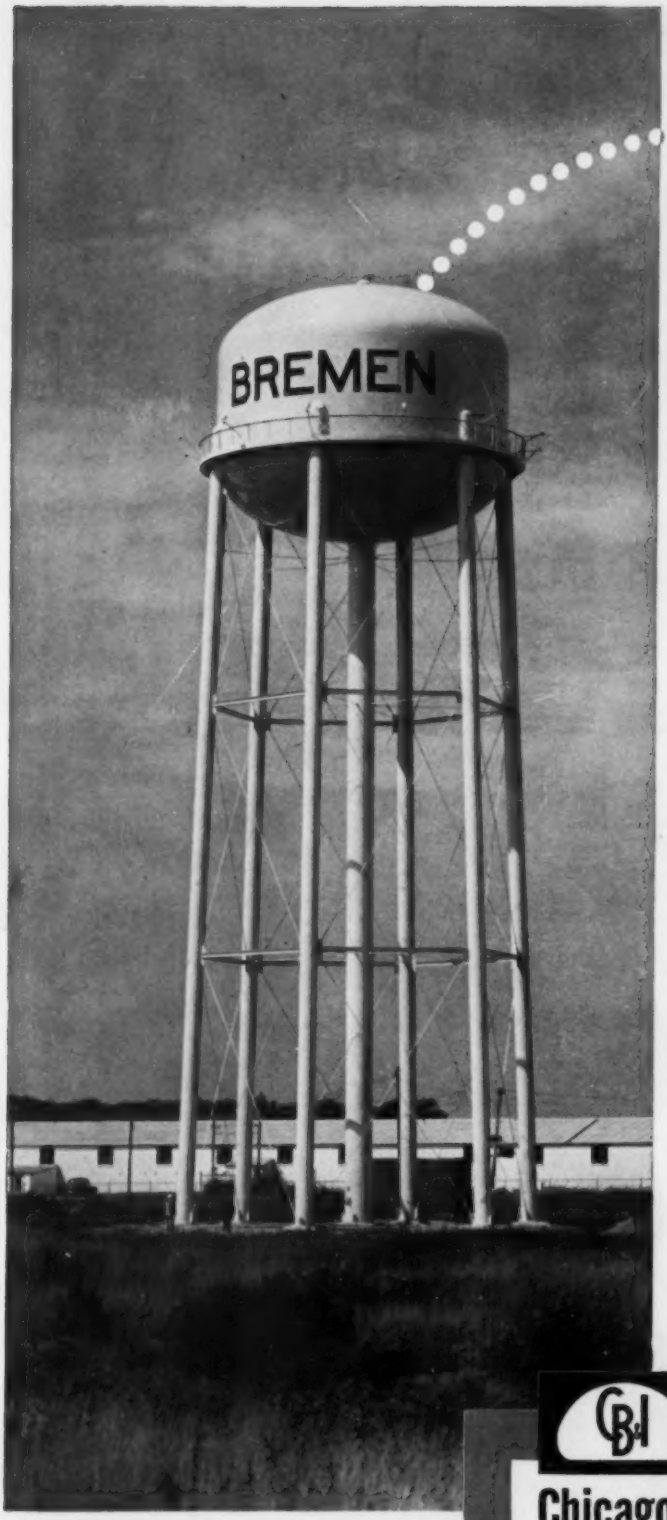
Its permanently-smooth, non-tuberculating bore is just one of the advantages of the *modern* pipe—K&M Asbestos-Cement Pipe. Other advantages: Easy installation under any weather and ground conditions; non-corroding inner and outer surfaces; high resistance to electrolytic action; permanence of joint obtained quickly with exclusive K&M "Fluid-Tite"® Coupling.

FOR PRESSURIZED MAINS to 200 psi, K&M Pressure Pipe meets A.W.W.A., A.S.T.M., and U.S. Federal Specifications.

Get the whole story on the modern pipe from the K&M distributor.

K·M
BEST IN ASBESTOS

KEASBEY & MATTISON COMPANY • AMBLER, PENNSYLVANIA
In Canada, it's ATLAS ASBESTOS CO. Ltd. 5600 Hochelaga St., Montreal, P.Q.
For "CENTURY" Pipe and "FLUID-TITE" Couplings



300,000 gallons of Improved Municipal Water Service

● Lagging distribution pressures during peak load periods plague many communities, especially in the summertime. This problem can be solved by a modern Horton® elevated tank, such as the 300,000-gal. tank at left, built for Bremen, Indiana. A Horton elevated tank stores a reserve of water that flows by dependable gravity pressure to meet peak load periods and smooth out pressure variations throughout the distribution system . . . resulting in better, more reliable water service to consumers.

Horton elevated tanks are built in sizes to 3,000,000 gallons. Write our nearest office for further information on how a Horton elevated tank can solve *your* distribution pressure problems.

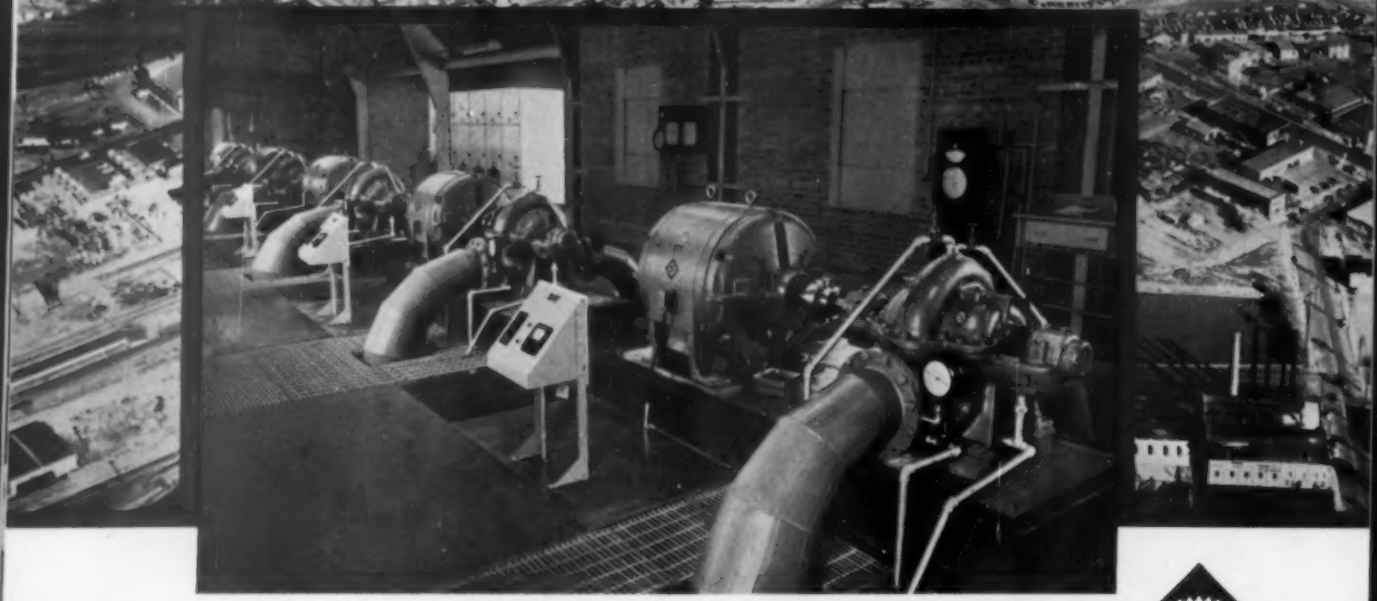
Above: 300,000-gal. Horton ellipsoidal bottom elevated tank erected at Bremen, Indiana. Plates for the tank were pickled and painted, using the Horton Pickling Process, before shipment from CB&I's plant.

CB&I

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New York • Philadelphia • Pittsburgh • Salt Lake City • San Francisco
Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

Pueblo,



Allis-Chalmers pumps, motors and control at the District No. 2 Water Works—two 12 x 10 SHS pumps, 3500 gpm, 290 ft, driven by 350-hp, 1770-rpm motors; and three 12 x 10 SH pumps, 6000 gpm, 290 ft, driven by 600-hp, 1770-rpm motors.

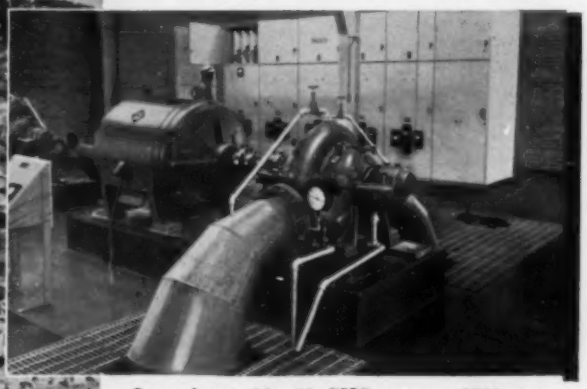
A-C ALLIS-CHALMERS

A-5397

Colorado

increases pump capacity...

Confidently purchases Allis-Chalmers equipment for continued satisfaction based on proven past performance



One of two 12 x 10 SHS pumps, 3500 gpm, 290 ft, driven by 350-hp, 1770-rpm motors, and line-up of Allis-Chalmers Type H high-interrupting capacity motor control.

One of two 12 x 10 SI pumps, 3500 gpm, 290 ft, driven by Allis-Chalmers 340-hp, 1200-rpm diesel engines.

THIS progressive industrial city of 100,000 expects to double its population in less than 30 years. This growth pattern called for increasing pump capacity to 41 mgd and provisions for future expansion. Because Allis-Chalmers equipment had given dependable, low-maintenance, high-efficiency service in the past, Pueblo assured itself of outstanding service by again specifying Allis-Chalmers.

Your community, too, can save time and money—assure itself of the same satisfaction—by conferring with Allis-Chalmers engineers early in the planning stage of your public works project. As the leading builder of public works equipment, Allis-Chalmers offers unequaled experience, vast resources of technical skill and modern, dependable equipment

Your local A-C representative will gladly call in a team of Allis-Chalmers experts to help you or your consultants plan a modernization or expansion program. Call him, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

Allis-Chalmers Public Works Equipment

- Hydraulic turbines, generators
- Pumps
- Compressors
- Condensers
- Blowers
- Motor-Generators
- Motors
- Transformers
- Switchgear
- Butterfly Valves
- Diesel Engines

ALLIS-CHALMERS

New Highway Construction Requires Pipe, In A Hurry!

AMERICAN
CAST IRON PIPE

The tremendous new highway construction program will require relocation of water, gas, and sewage lines in communities throughout the country.

The relocation of the old Dublin Road Force Main in Columbus, Ohio, is an example.

Speed, both in furnishing pipe and installing it, will be required. Long, trouble-free service, including resistance to impact loads and other stresses as well as resistance to corrosion once the pipe is installed, will also be required.

American Cast Iron Pipe Company service and centrifugally cast pipe meet these requirements:

- **Sales offices and shipping points near you help speed delivery.**
- **Easy-to-assemble, bottle-tight joints help speed installation.**
- **Strength, durability, and corrosion-resistance assure long trouble-free service.**

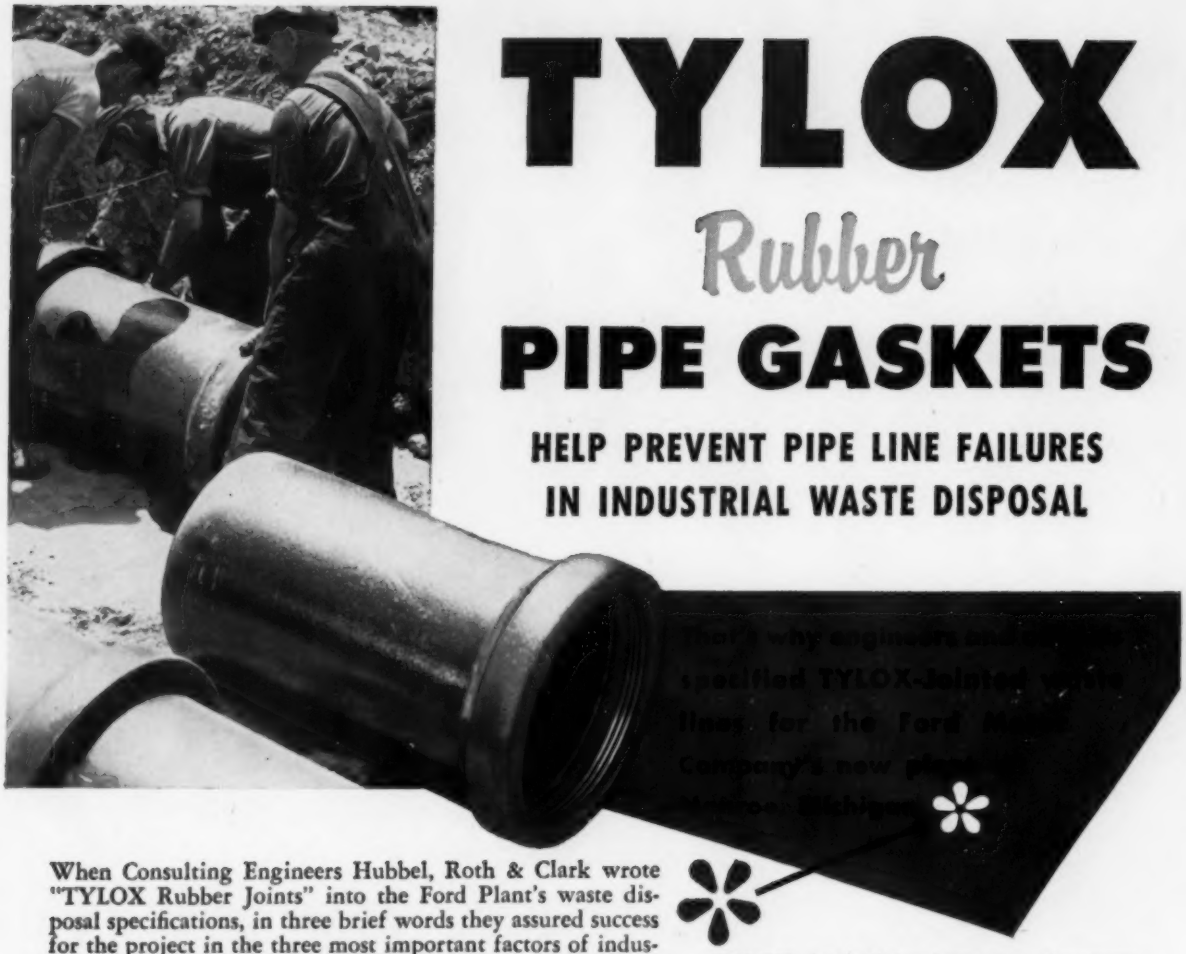
Specify American Cast Iron Pipe. A call to our Sales Office nearest you will bring both information and assistance.

36" American Double-X Mechanical Joint Pipe, with Enameline lining, being installed in Columbus, Ohio, for water service.

AMERICAN CAST IRON PIPE CO.
BIRMINGHAM 2, ALABAMA

SALES OFFICES

New York City	Chicago
Kansas City	Minneapolis
Dallas	Los Angeles
San Francisco	Orlando
Pittsburgh	Cleveland
Seattle	Denver



TYLOX
Rubber
PIPE GASKETS

HELP PREVENT PIPE LINE FAILURES IN INDUSTRIAL WASTE DISPOSAL

When Consulting Engineers Hubbel, Roth & Clark wrote "TYLOX Rubber Joints" into the Ford Plant's waste disposal specifications, in three brief words they assured success for the project in the three most important factors of industrial sewerage and drainage pipe work. Here's why:

TYLOX IS CORROSION PROOF — Destructive acid action works overtime in industrial sewers, but can't harm TYLOX Joints. They're made of acid and alkali-resistant rubber which safely handles corrosive wastes.

TYLOX IS LEAK PROOF — *Multiple* sealing surfaces, all under compression, keep waste water in, and ground water, roots and sediment *out* of the pipe. No infiltration . . . no exfiltration with TYLOX; therefore no costly line failures resulting from either.

TYLOX IS FLEXIBLE — Shock loads . . . heavy overburdens . . . deep fills . . . all acute factors in industrial areas, can't rupture the TYLOX *compression* seal.

These TYLOX advantages, *plus* their cost-saving speed of installation and long life (they outlast the pipe itself) are why leading engineers are regularly specifying TYLOX for big and little pipe jobs the world over. Specify TYLOX RUBBER JOINTS to protect *your* next pipe project from the troubles and cost of joint failures.

Write today for complete specification data and literature on TYLOX Rubber Pipe Joints

PROJECT: *Ford Motor Company — Treatment Plant at Monroe, Michigan*

ENGINEERS: *Hubbel, Roth & Clark, Detroit, Michigan*

PIPE: *Vitrified Clay with integrally cast TYLOX Rubber Joints. Manufactured by Universal Sewer Pipe Corporation, Cleveland, Ohio*

CONTRACTORS: *Robert Carter Company, Toledo, Ohio*

TYPE "B" GASKET
For Bell-and-Spigot Pipe

This rubber-tight mechanical seal stays tight "for the life of the line."

1957

HAMILTON KENT MANUFACTURING CO.

NEW SIMPLEX ELECTRO-PNEUMATIC SYSTEM PROGRAMS FILTER WASHING AUTOMATICALLY

Fully-interlocked System Regulates Flow; Shuts Down, Washes, Rinses, and Reopens Filters

Now simplicity, efficiency and manpower savings come to filter plants with the new Simplex Automated Filter Operating Table.

From one central point, filtering and washing cycles can be initiated automatically . . . all rates and times maintained accurately. Valve action is completely pneumatic! The system contains no electrical devices that might malfunction in the dampness of a wet pipe gallery.

Shut-off and Cut-off

This new system automatically shuts off a filter if the clearwell is filled—returns it to service when needed. Depending on the control you prefer, a filter will be automatically removed from service for backwashing when (1) loss of head reaches cut-off point you pre-set (usually 8') or (2) electric timer has run through the value you pre-set (80 to 120 hrs.). At any point, the operator can manually over-ride these automatic controls.

No-Flood Washing

When automatic program starts, the filter Influent Valve is closed, water level drops to wash-trough lips, then the filter Effluent Valve is closed.

Next the Drain Valve is opened, followed by the Wash-Water Valve. Pneumatic interlocks prevent flooding: wash valve can't open until drain valve is fully open.

Washing is precisely timed at slow-fast-slow rates . . . so bed is cleaned and hydraulically graded for clean starts and optimum results.

Saves Treated Water

To prevent flooding, Drain Valve can't close until all Wash Valves have first closed. To prevent waste of treated water, filter Influent Valve can't open until drain valve has completely closed. Washing period can be extended, if desired.

NEW SIMPLEX AUTOMATED FILTER TABLE: Large dials indicate and/or record rate of flow and loss of head. Smaller dials set filtration and wash rates. Colored lights show progress of the automatic cycle. Manual levers permit operator to over-ride the automatic programming at any point.

Controlled Starts

To prevent turbid starts, when the Influent Valve is opened, the Effluent Valve stays closed until water reaches operating level. Float switch then opens Effluent Valve.

No Sequence Errors

Cascade programming makes mistakes impossible. All valves open and close in their proper sequence.

Automated Filter Plants

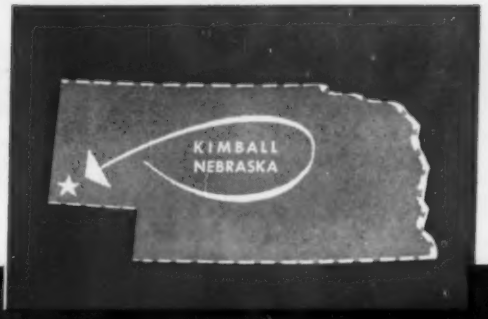
Obviously the control functions built into this new Simplex Table can also be used to control a series of filters. We'll gladly discuss your plans for integrated sequential control that interlinks all filters for fully automatic operation of an entire filter plant.

Your Plans

We'll gladly rush further details or a Bulletin to help you evaluate this important Simplex development. Write Simplex Valve & Meter Company, Dept. WS-6, 7 E. Orange Street, Lancaster, Pa.

SIMPLEX®
VALVE AND METER COMPANY

Kimball's power plant saves $58,000 yearly!



powered by . . .

SUPERIOR DUAL-FUEL ENGINES

Six years ago, fast-growing Kimball, Nebraska decided to modernize its inadequate power plant. Today, powered by three Superior Dual-Fuel Engines, Kimball's power plant is saving $58,000 a year over private utility rates. The engines operate with natural gas at an average cost of 6.93 mills per KWH. On diesel fuel alone power costs are 10 mills per KWH, and annual savings would be $35,000.

The first engine paid for itself in savings in less than three years! Repeat orders later demonstrated the confidence of Kimball city fathers in Superior engine quality. As a further bonus, the three engines are expected to give good service for 35 to 40 years, according to the town's Public Works Director.

Such *savings*, *satisfaction* and long-term *service* are characteristic of White's Superior engines. See how you can participate in "Kimball-type" savings. Call or write the nearest office listed below. Let White's engineers discuss the new features of Superior and Atlas engines, ranging from 100 to 2150 H.P., for power to 1500 KW.

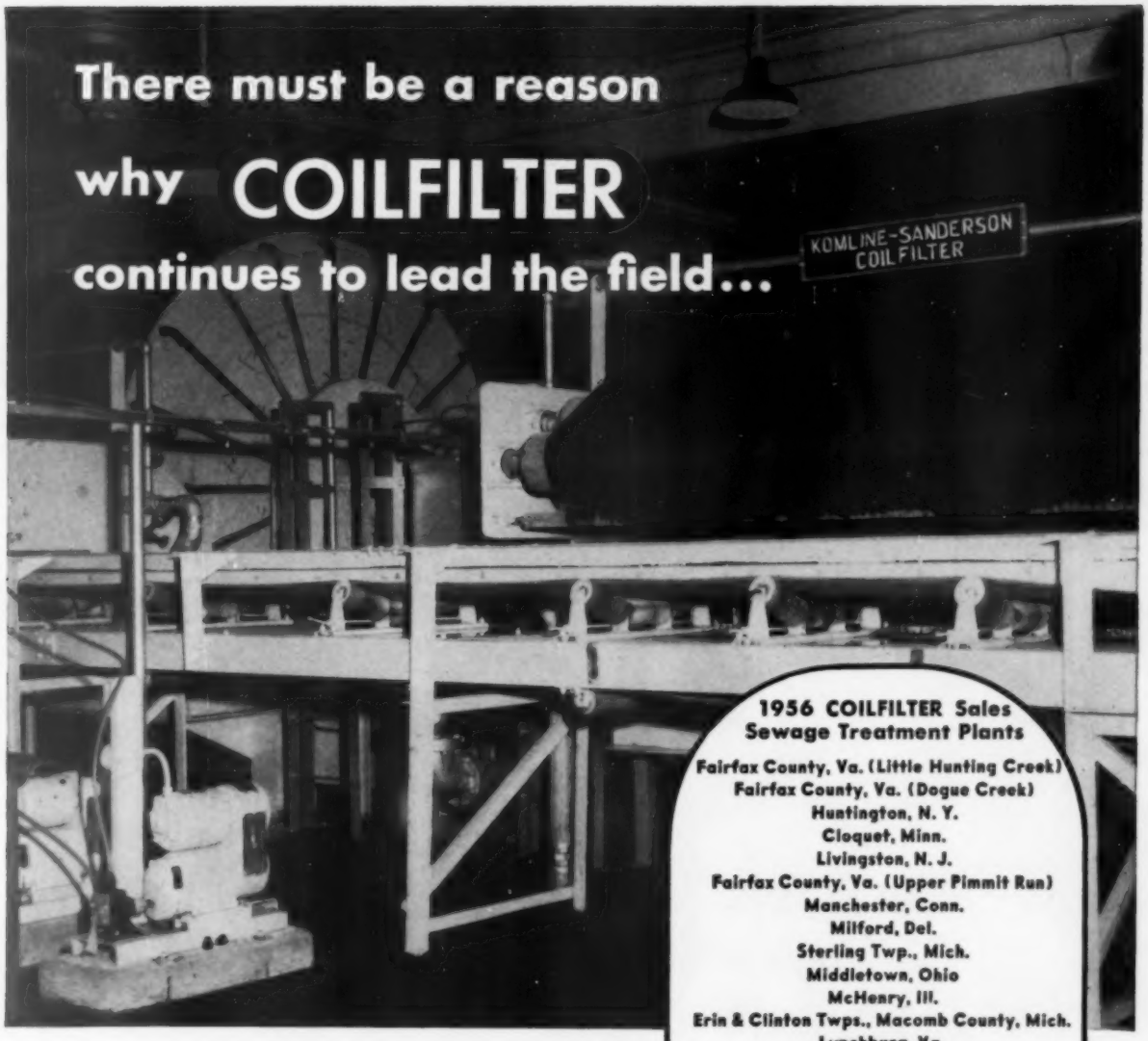
White Diesel

WHITE DIESEL ENGINE DIVISION

THE WHITE MOTOR COMPANY Plant and General Offices: Springfield, Ohio

SALES AND SERVICE POINTS: Ketchikan, Alaska • San Francisco, Terminal Island, California • Denver, Colorado • Washington, D. C. • Clearwater, Florida • New Orleans, Louisiana • Boston, Mass. • Park Rapids, Minnesota • Webster Groves, Missouri • Callaway, Nebraska • New York, New York • Portland, Astoria, Oregon • Ft. Worth, Houston, Texas • Seattle, Wash. • Halifax, Nova Scotia • Vancouver, B. C.

There must be a reason why COILFILTER continues to lead the field...



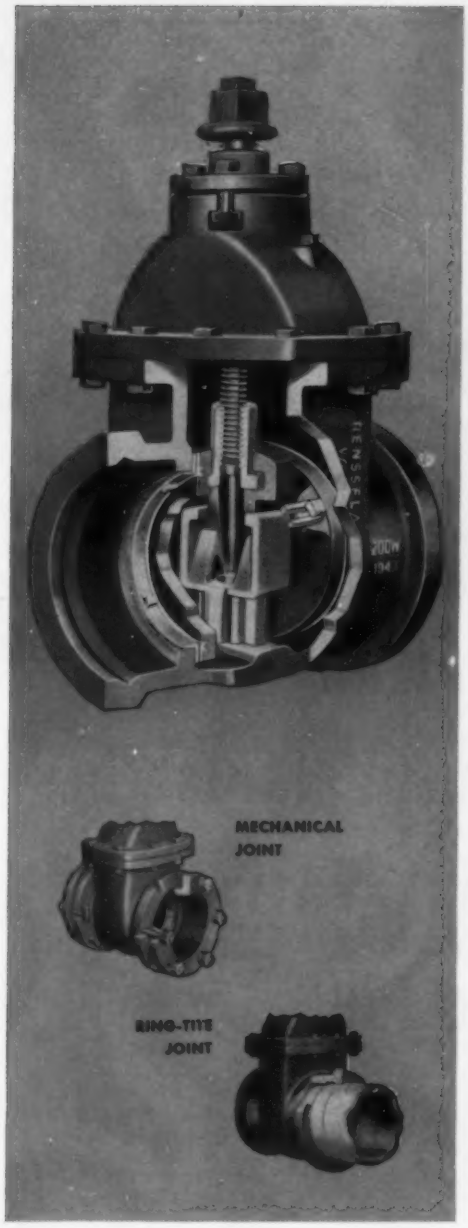
1956 COILFILTER Sales
Sewage Treatment Plants

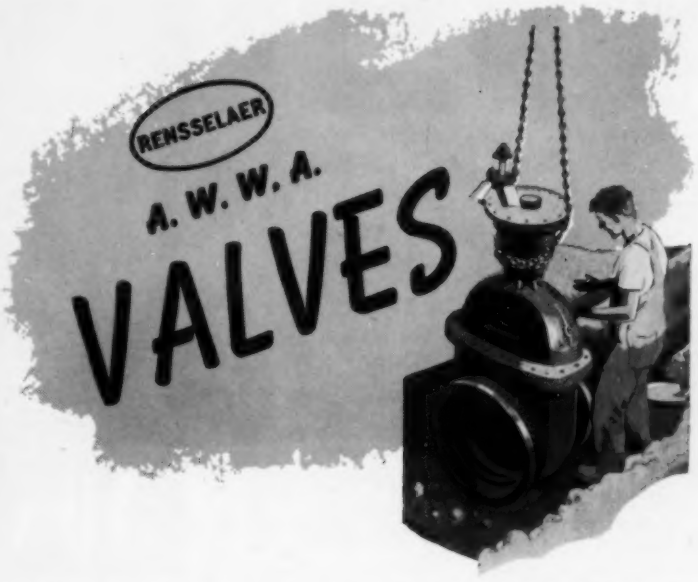
Fairfax County, Va. (Little Hunting Creek)
Fairfax County, Va. (Dogue Creek)
Huntington, N. Y.
Cloquet, Minn.
Livingston, N. J.
Fairfax County, Va. (Upper Pimmit Run)
Manchester, Conn.
Milford, Del.
Sterling Twp., Mich.
Middletown, Ohio
McHenry, Ill.
Erin & Clinton Twps., Macomb County, Mich.
Lynchburg, Va.
Clinton Twp., Mich.
East Liverpool, Ohio
Farmington, Ill.
Carrollton Subdivision, St. Louis Co., Mo.
Cayuga Heights, N. Y.
Collingswood, N. J.
Belton, Mo.
El Dorado, Kansas
Louisville, Ky.
Trenton, Mo.
Haddon Twp., N. J.
North Battleford, Saskatchewan, Canada
Nashville, Tenn.
Moundsville, W. Va.
Penn. State University, University Park, Pa.
Treasure Island, Fla.
Campbell, Ohio
Herrin, Ill.
Piqua, Ohio
Superior, Wisc.
High Point, N. C.
Montgomery Co., Ohio (Moraine Plant)
Greensboro, N. C. (So. Buffalo Creek)
Neenah-Menasha, Wisc.

Yes, there is a reason, in fact, many reasons, why COILFILTERS again in 1956 far outsold competitive filters in the municipal sewage treatment field. These reasons all add up to economical, dependable performance, ease of operation and extremely low maintenance costs.

KOMLINE-SANDERSON ENGINEERING CORPORATION
Peapack, New Jersey

Manufacturers of **COILFILTER** *sludge vacuum filters*





It costs more to dig up a valve than it does to be sure that the valve is right in the first place. Rensselaer A.W.W.A. Valves have been giving satisfactory service in hundreds of cities for many years, and there are many "reasons why."

The well known Rensselaer wedge mechanism, for instance, presses the gates firmly against the valve seats on closing, but on the first turn of the opening, the wedging mechanism is released and the gates are free.

The generous use of solid bronze, the rust proofing and the simplicity of servicing make for long life and low maintenance. All parts are interchangeable and accurate because of the precision casting and machining.

Only two types of valve ends are shown. All types are available together with tapping valves and other accessories.

The names, Ludlow and Rensselaer mean the same today that they have during your lifetime. The desire to serve the Water Works Field in person—in research and design and in prompt delivery of original equipment and spare parts for all products has not changed.

Ask for Bulletin "A"

16

LUDLOW & Rensselaer

LUDLOW RENSSELAER **VALVES & HYDRANTS**

Since 1861 **THE LUDLOW VALVE MANUFACTURING CO.** *Troy, N. Y.*

ALABAMA
Mobile

ARKANSAS
Corning

CALIFORNIA
San Francisco
Vallejo
Novato
Sacramento
Yountville
Berkeley
Palo Alto

COLORADO
Golden

CONNECTICUT
South Meriden

DELAWARE
Milford

FLORIDA
Pensacola

ILLINOIS
Homewood
Palatine

INDIANA
Connersville
Bloomington
Madison
Kokomo
Seymour
Portland
Indianapolis
New Whiteland
Aurora

IOWA
Dubuque

KANSAS
Caney
Sterling
Merriam
Mission

KENTUCKY
Louisville
Henderson
Hopkinsville
Cynthiana

MARYLAND
Baltimore

MASSACHUSETTS
Clinton
So. Weymouth

MICHIGAN
Ontonagon
Marine City
Blissfield
Warren

MINNESOTA
St. Cloud
Bemidji
Albert Lea

NEBRASKA
Omaha

NEW JERSEY
Atlantic City
South Amboy
Passiac Valley
Livingston

NEW YORK
Cheektowaga

OHIO
Portsmouth
Dayton
Sidney
Toledo
Greenfield
Wayne
Trotwood
Jefferson
Eaton
Hilliard

OKLAHOMA
Tulsa
Sand Springs
Dewey
Drumright

PENNSYLVANIA
Slippery Rock
Erie
Slatington
Mount Joy

RHODE ISLAND
Newport
West Warwick
Providence

TEXAS
San Antonio

WASHINGTON
Monroe
Tumwater
Silverdale

WISCONSIN
Sheboygan
Sturgeon Bay
Gillett

MANITOBA
Winnipeg
Bird

ONTARIO
Trafalgar
Clarkson
Toronto
Kingston
Port Hope

Just a few...

of the many sewage treatment plants where DeZurik Valves are on the job!

In sewage treatment plants throughout the country, plant personnel are finding that DeZurik Valves stand up to tough sewage applications that easily destroy ordinary valves!

DeZurik Valves shut dead-tight every time—despite solids in the flow! They open and close easily—without lubrication! Their resilient-faced plugs resist abrasion from solids in the flow, eliminating scoring on the plug face, an eventual source of leakage. Exclusive eccentric action guarantees *easy operation* without lubrication! The plug is pivoted eccentrically in the valve body and touches the body *only* when the valve is closed. There's no friction, no binding, no jamming!

DeZurik Valves perform with equal excellence on all lines—from heavy sludge to gas.

Representatives in all principal cities.

Or write to

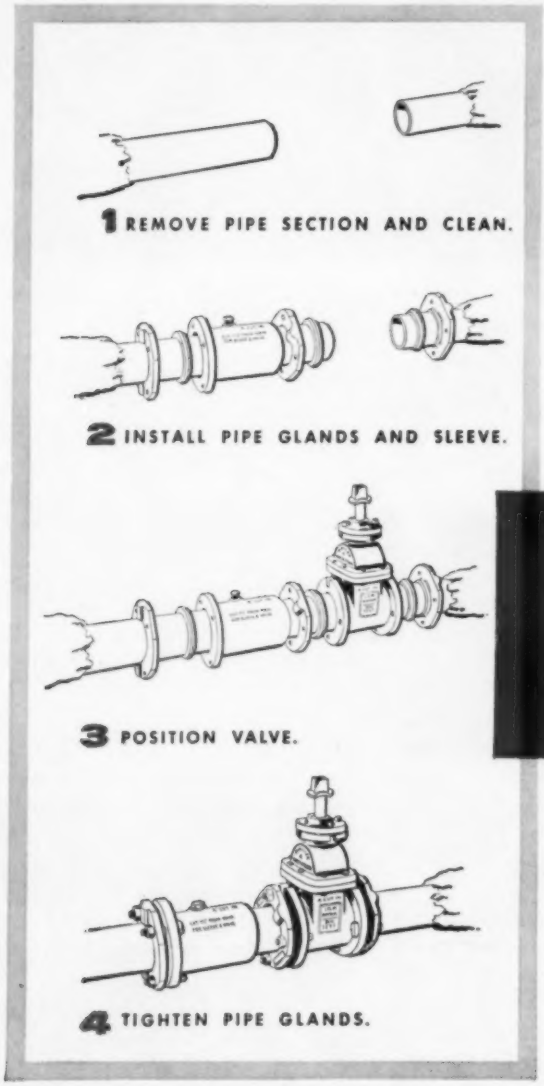
DeZURIK CORPORATION
SARTELL, MINNESOTA.

MUELLER

cut-in sleeve and valve

add control points on the line

You can install additional control points on an existing main with a minimum of inconvenience. A short section is cut out of the main and the Mueller Cut-In Sleeve and Valve installed quickly, easily and at low cost without breaking pipe joints.



The sleeve and valve are equipped with mechanical joint-ends to give fast, permanent connections. A choice of end gaskets for different classes of pipe assures a leak-proof connection. This permits installation of a valve and sleeve of a nominal size on virtually any class of pipe normally used for distribution.

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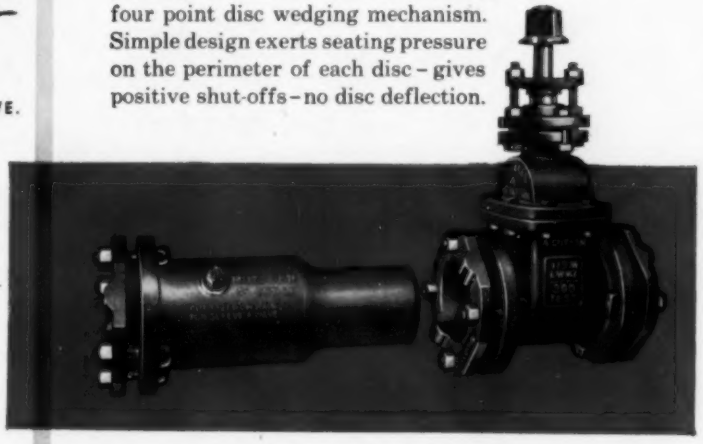

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WATER & SEWAGE WORKS

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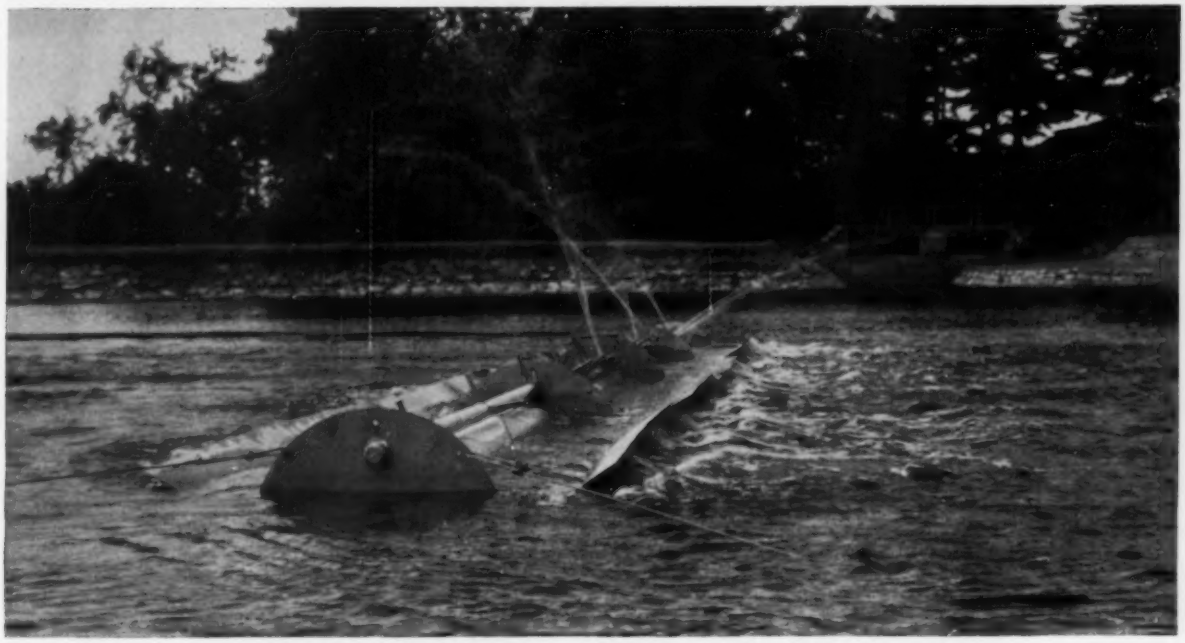


AERATOR in Ossining, N. Y. reservoir eliminates stagnant stratification.

Forced Circulation of Reservoir Waters

Yields multiple benefits at Ossining, N. Y.

by THOMAS M. RIDDICK

Mr. Riddick is a consulting engineer and chemist in New York City. In this article he describes a low-horsepower method of aerating and chemically treating a stagnant and stratified storage reservoir to gain aerobic conditions.

A STRATIFIED reservoir 28 ft deep and having a capacity of 103 mg was thrown into continuous circulation by the employment of a floating aerator having an input of only 8 hp. This has resulted in some very beneficial effects, and seems to offer many potentialities for both water and waste treatment.

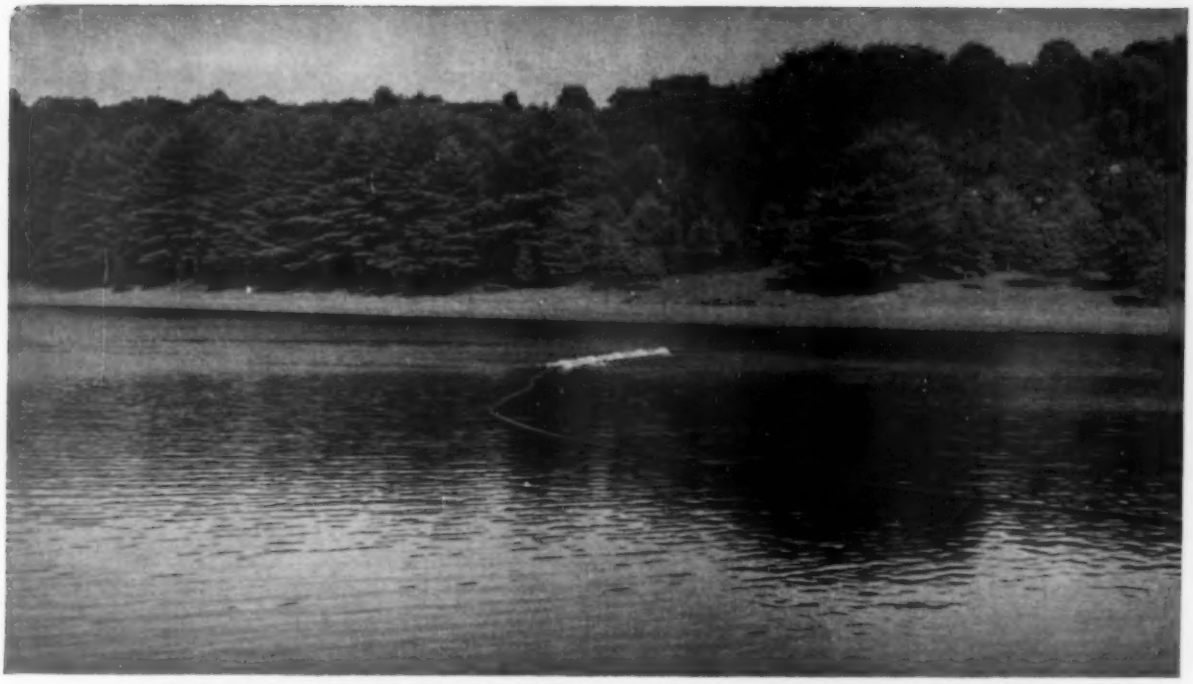
Indian Brook Reservoir at Ossining, N. Y., was formed about 1888 when a 25-ft dam was constructed to impound approximately 80 mg. The dam was later raised 5 ft, which increased storage to 103 mg. This reservoir is the principal source of water supply for the filtration plant serving the Village of Ossining.

Preliminary Work

Natural alkalinity of the raw water has ranged from 14 to 18 ppm, which is sparse for coagulation. Also, alkalinity of the finished water (after the addition of secondary lime to raise pH to 8.6-9.0) is insufficient to adequately control corrosion.

Various methods for increasing the natural bicarbonate alkalinity of the reservoir water have been considered in the past, including conversion of milk of lime by dry ice or compressed carbon dioxide, and other devices. Fifteen tons of lime were distributed over the ice cap several years ago with moderate (though temporary) success.

Since there is adequate carbon dioxide in the atmosphere (0.03% by volume) the problem was to formulate a practical and economical method of utilizing this. If milk of lime could be applied to the reservoir and kept in suspension, and if appreciable recirculation of the water could be effected to result in a constantly renewed air-water interface, absorption of sufficient carbon dioxide to convert all lime to calcium bicarbonate seemed possible.



OVERTURN of entire reservoir increases aerobic activity and reduces chance of winter freezing.

Aerator Installed

In July 1956 a floating aerator of original design was installed on this reservoir at the location shown in Fig. 1. The total length of the aerator is 40 ft. Free air at the rate of 160 cfm was continuously discharged through air release nozzles set on 1-ft centers at approximately 7½ ft below the water surface. Three 2-in. diameter plastic hose lines (each 400 ft in length) are wired together and extend from the filter plant to the aerator. Two of these convey air from the compressor, their buoyancy supporting the third line, which conveys milk of lime.

By mid-July 1956 reservoir capacity had been reduced to 80 mg and there was little or no inflow in excess of that required to compensate for evaporation losses. Water for the 2-mgd filtration plant was thereafter (for the duration of the test period) withdrawn direct from Old-Croton Aqueduct.

Fig. 1 shows the position of the

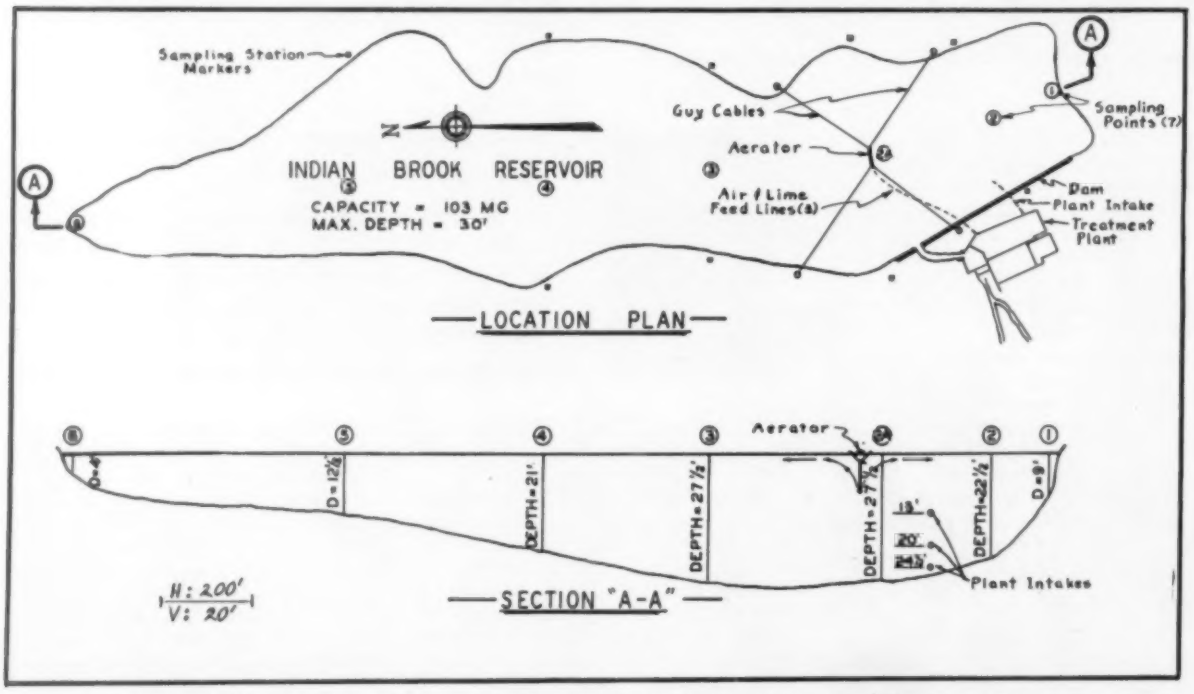


Fig. 1—PLAN and section of reservoir, showing aerator location, water depth, and sampling points.

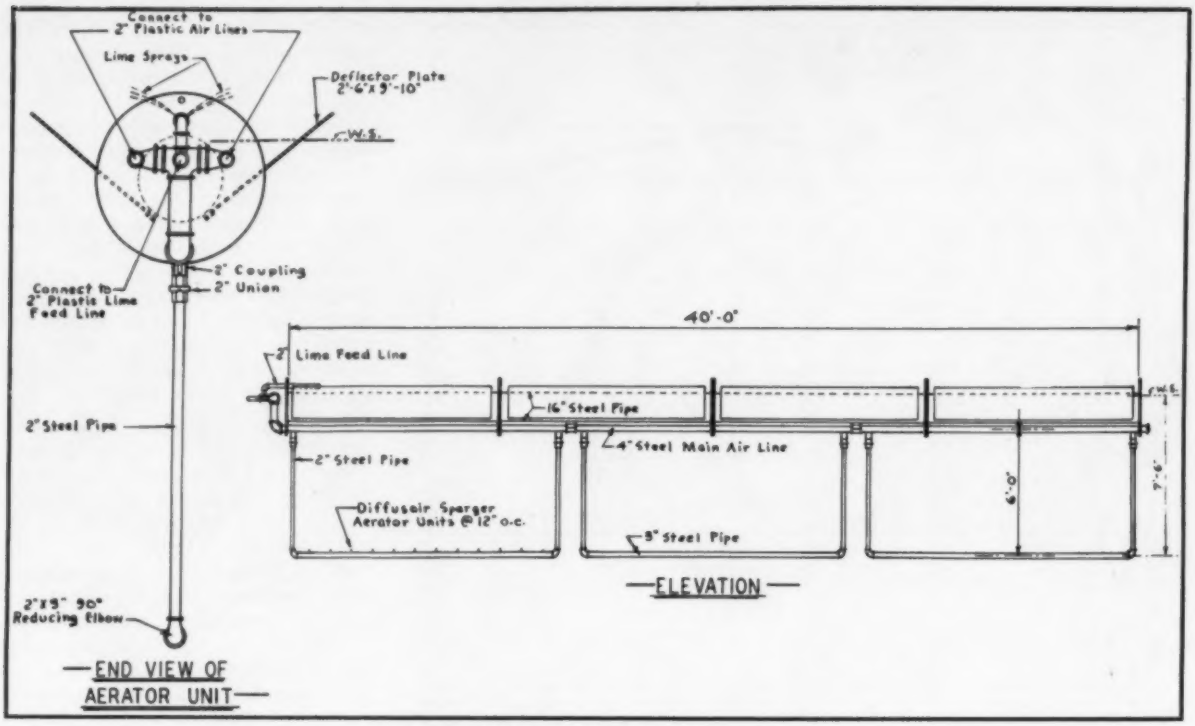


Fig. 2—DESIGN details of floating aerator.

aerator in the reservoir in relation to the seven sampling points and also to the intake. Sampling depths ranged from 9 to 27½ ft, with sampling point 6, at the shallow end, approximating 4 ft. Width of the reservoir approximates 400 ft, and length 2,250 ft. The aerator was positioned 450 ft from the south end and 1,750 ft from the north end, and was held in place by four ¼-in. steel guy cables because the tendency to yaw laterally proved very pronounced.

Fig. 2 is a self-explanatory detail drawing of the aerator. The deflector plates are for lateral deflection of the upwelling flow. The 16-in. steel pipe (WT 0.20 in.) served principally as a float, as well as providing a rounded surface at the bottom. Four 10-ft sections were employed instead of one 40-ft length to enable easy fabrication and assembly.

Milk of lime (approx. 30 gpm) was discharged for a period of about 12 hr each day through a spray pipe set atop the aerator.

To establish normal conditions prevailing in the stratified reservoir, several sets of samples were collected from the surface to the bottom, at points 1 through 6, from July 16 to July 22. Determinations were made of temperature, dissolved oxygen, pH, alkalinity, and color.

The aerator was placed in service about noon, July 23, and samples were collected at frequent intervals from this date to July 30. The total number of samples approximated 450 and all analytical work was done by or under the supervision of T. A. Wastler of the Robert A. Taft Sanitary Engineering Center, USPHS, Cincinnati, Ohio. Since the tabulated data are so voluminous as to be confusing, and since samples from all sampling points and at all depths show essentially the same picture, data from sampling points 2, 3, and 4 only will be graphically set forth as typical.

Test Results

The reservoir was well stratified on July 16, as shown (Fig. 3) by sampling point. Temperatures ranged from 78°F at the surface to 52°F at the bottom.

The aerator was operated several

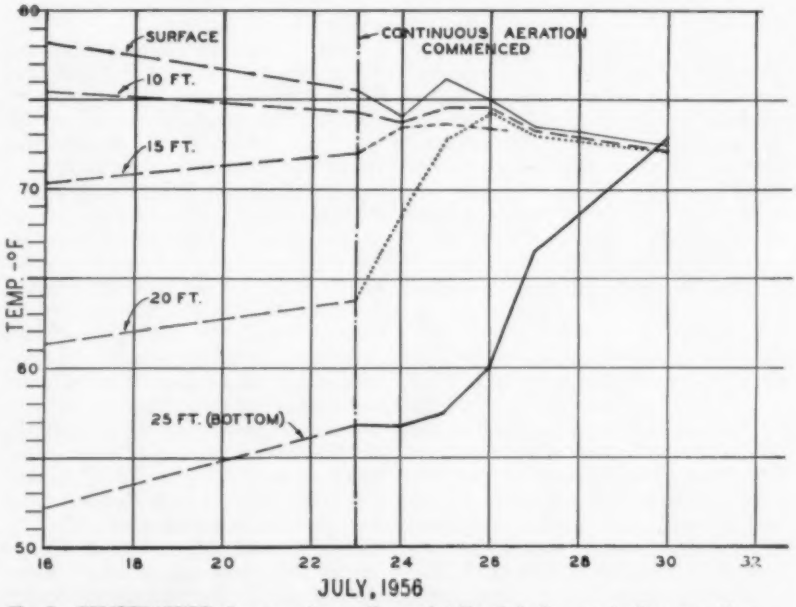


Fig. 3—TEMPERATURE changes at sampling point No. 3, before and after aeration.

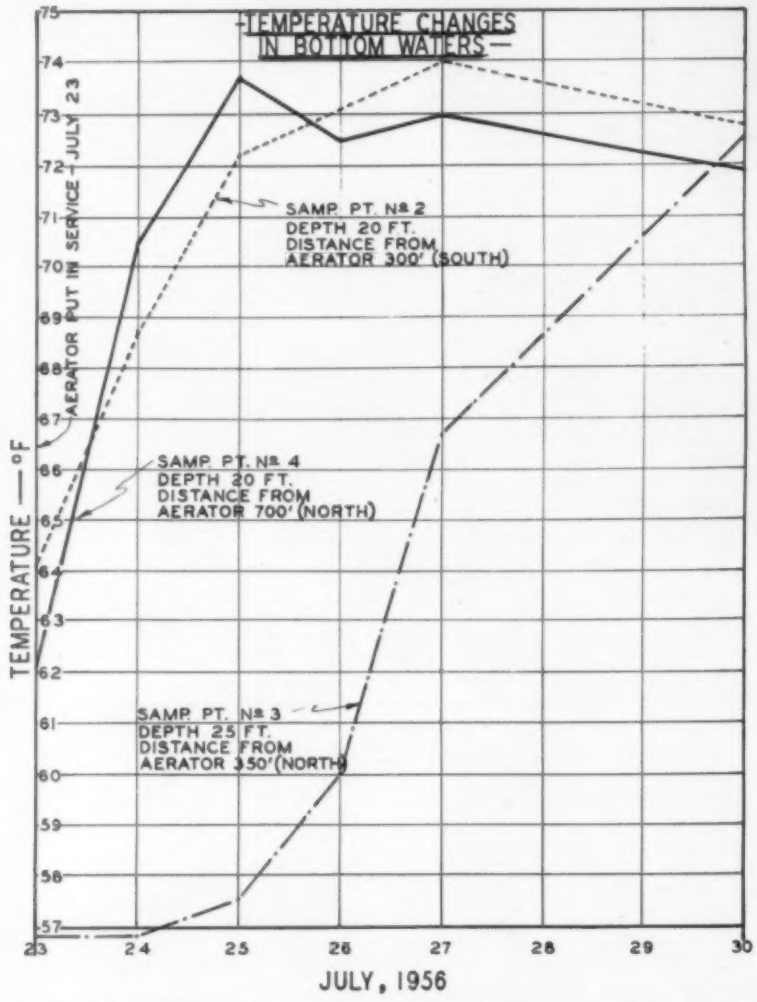

TEMPERATURE CHANGES IN BOTTOM WATERS
AERATOR PUT IN SERVICE JULY 23
SAMP. PT. No. 2 DEPTH 20 FT. DISTANCE FROM AERATOR 300' (SOUTH)
SAMP. PT. No. 4 DEPTH 20 FT. DISTANCE FROM AERATOR 700' (NORTH)
SAMP. PT. No. 3 DEPTH 25 FT. DISTANCE FROM AERATOR 350' (NORTH)
TEMPERATURE — °F
JULY, 1956

Fig. 4—BOTTOM WATER temperature changes at sampling points 2, 3 and 4, after the commencement of aeration.

times from July 16 to July 22 for periods of less than 1 hr, the shutdown in each instance being due to breakage of the guy cables holding the aerator in place. This condition, and the fact that simples were collected in the late afternoon of July 23, accounts for the slight change in values noted from July 16 to July 23.

It will be noted that from July 23 to July 26 temperature at the 20-ft level rose from 64° to 74°F and at the 25-ft level from July 23 to July 27, temperatures increased from 57° to 67°F. Stratification at the 15-ft depth was broken in one day, at the 20-ft depth in 2 to 3 days, and at the 25-ft depth in 4 to 6 days. When this installation was planned it was not known whether stratification in the zone of stagnation could be broken at all, particularly in view of the 27-ft depth as contrasted with only 7½-ft submergence of the air releasers.

Temperature changes in bottom waters at sampling stations 2, 3, and 4 are shown in Fig. 4. Sampling point 2 was located 300 ft south of the aerator; sampling points 3 and 4 were 350 and 700 ft, respectively, north of the aerator. Bottom waters at sampling point 2 were well within the zone of stagnation and the rise in temperature from 64° to 72°F in two days shows that the aerator is quite effective at this depth. At sampling point 3, which is the deepest part of the reservoir, the immediate effect was less pronounced and approximately two days of circulation were required to put this water in motion. During the next two days (July 25 to 27) water increased in temperature from 57.5° to 66.5°F and reached complete equilibrium from top to bottom by August 30. The curves at sampling points 2 and 4 are almost identical, although these stations are 1,000 ft apart. This emphasizes that stratification was readily broken at the 20-ft depth, but water pocketed in the deepest section (25-ft depth) was much more difficult to put in motion.

Fig. 5 shows dissolved oxygen changes in bottom water at these three sampling points. It will be noted that at sampling points 2 and 4, where water depth approximated 20 ft, dissolved oxygen increased from approximately 1 to 6 ppm in a 2-day period after the aerator was placed in service. There was an appreciable lag at sampling point 3, probably due to increased depth and to the pocketing effect previously noted.

Fig. 6 shows changes in dissolved oxygen from top to bottom at sampling point 3, before and after placing the aerator in service. Here again it will be noted that waters at the 10- and 15-ft depths responded to circulation immediately, as is manifest by an increase in dissolved oxygen, whereas a delay of two days was manifest at the 20-ft depth and about one week at the 25-ft level.

It must be borne in mind that the inertia of 80,000,000 gal (333,000 tons) of water is very appreciable and it is interesting that this could be overcome by an input of only 8 hp in so short a time interval.

Dive Observations

A few hours after placing the aerator in service a sub-surface examination (with a diver's face mask) was made to evaluate bubble formation. Whereas surface water temperature off the ends of the aerator was warm (about 75°F) the rising water in the vicinity of the aerator was perceptibly cold. It was therefore evident immediately that water was being drawn from at least the zone of transition, and possibly from the zone of stagnation.

A dive was made to below the air releasers and a handkerchief was spread horizontally about 1 ft below the pipeline to which the air releasers were attached. The up-drift of this showed that water was upwelling from immediately below the spargers. These units were manufactured by Walker Process Industries and consist of a ¾-in. openings located equidistant around the periphery of a circular plate.

Bubble size, as visually evaluated, seemed to range from 1- to 2-in. in size at the lower depth. These generally broke down with one or two feet of upward travel to smaller sizes, says ½- to 1-in., or else increased in size (through agglomeration) to 4- to 8-in. diameters.

More Test Results

To ascertain the quantity of water being pumped, current-meter measurements were taken near the two ends at the center on both sides of the aerator. These data are shown in Fig. 7. Velocity 3 in. below the surface (sufficient to immerse the current-meter) approximated 1.5 fps; at 2-ft depth 0.5 fps; and at 4-ft depth 0.3 fps. All measurements were made 10 ft off the centerline of the aerator. The quantity of water pumped, therefore, approximated 236 cfs, 153 mgd, or 107,000 gpm.

The horsepower input was approximately 8. This was equivalent to raising 153 mgd a total height of 3.5 in. This seems a remarkably large quantity to be pumped by so small a unit, and represents a complete turnover of the reservoir between once to twice a day.

The dissolved oxygen content of surface waters approximated 8 ppm (about 95 to 100% saturation) at the beginning of the test period. After a week of operation, D.O. values throughout the reservoir approximated 6.5 ppm, or 75 to 80% saturation, due to the oxygen demand of bottom sediments. The D.O. of all waters, top to bottom, about one month after commencement of aeration approximated 90%, with 5-day 20°C B.O.D. approximating 3 ppm. This rather unanticipated organic loading prevented any accurate estimate of the amount of oxygen being introduced daily by the overturn of water.

Initially the iron concentration in the top waters was 0.1 to 0.2 ppm, increasing to 1.5 to 2.0 ppm in the zone of stagnation. Iron concentrations 30 days after commencement of aeration approximated 0.1 to 0.2 throughout the reservoir.

The reservoir remained in substantially continuous circulation from July 23, 1956, to mid-January 1957. At this time, and during a period of very cold weather, a guy cable broke, also pulling away the air hoses. The reservoir promptly froze over, and thereafter the aerator has been out of service.

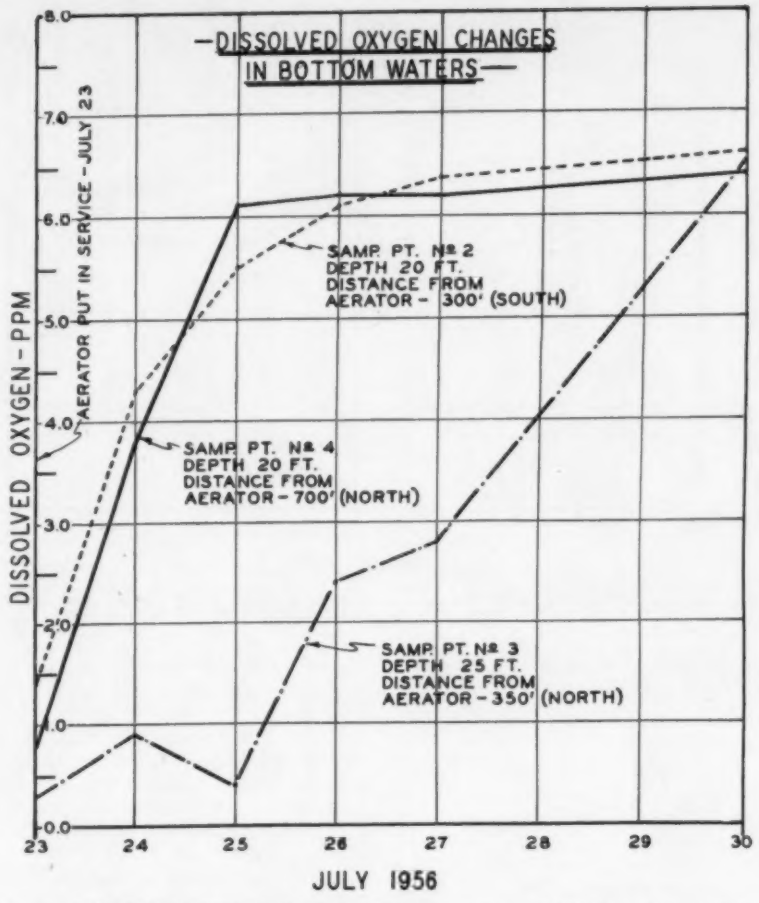


Fig. 5—DISSOLVED OXYGEN changes in bottom waters at Stations 2, 3, and 4, after aeration started.

Some Conclusions

It is too early to fully appraise the effects of producing continuous circulation in reservoir waters. However, the following conclusions seem reasonable:

1. Reservoirs with capacities as large as 80 mg can be effectively overturned by an aerator releasing 160 cfm of free air 7½ ft below the water surface, and with a horsepower unit of not more than 8.

2. The rate of recirculation in the vicinity of the aerator approximated 153 mgd, or one to two complete overturns a day.

3. Moderately high surface velocity is visually evident a distance of 50 to 150 ft off both sides of the aerator.

4. The actual "throw" of water was at least 1,750 ft, as shown by results at Station 6. This is further confirmed by the migration of a bottle, weighted with sand so that only 1 in. of the neck extended above the water surface, from the aerator to the far (inlet) end.

5. The discharge of water is at right angles to the axis of the aerator and this exerts both a "pushing" as well as a "pulling" action. Float tests indicate that water travels from the aerator to the end of the reservoir, fans out and then returns partly at the sides of the reservoir. How much of this returns at the bottom is unknown. A portion of the return water may be along the bottom, or it may be that bottom water is removed entirely by being "drawn-up" by the aerator.

6. Indications are that iron in the thermocline and zone of stagnation was oxidized and precipitated, as ferric hydrate, probably at the far ends of the reservoir.

7. Color was reduced in two to three months from 55 to 60 ppm to about 15 to 20 ppm. This was probably due principally to sunlight, although some color may have been removed by the ferric hydrate.

8. Carbon dioxide was reduced to normal (atmospheric) saturation values (1 to 3 ppm) throughout the entire depth of the reservoir. When the reservoir was stratified, normal values in the zone of stagnation ranged from 10 to 20 ppm.

9. The bicarbonate alkalinity of the reservoir water was readily increased from 15 to 35 ppm without ever resulting in hydrate or carbonate alkalinity. pH values leveled off in the range of 6.8 to 7.3.

10. Microscopic examinations show total counts to have been reduced by 50 to 80% from a normal of 200 to

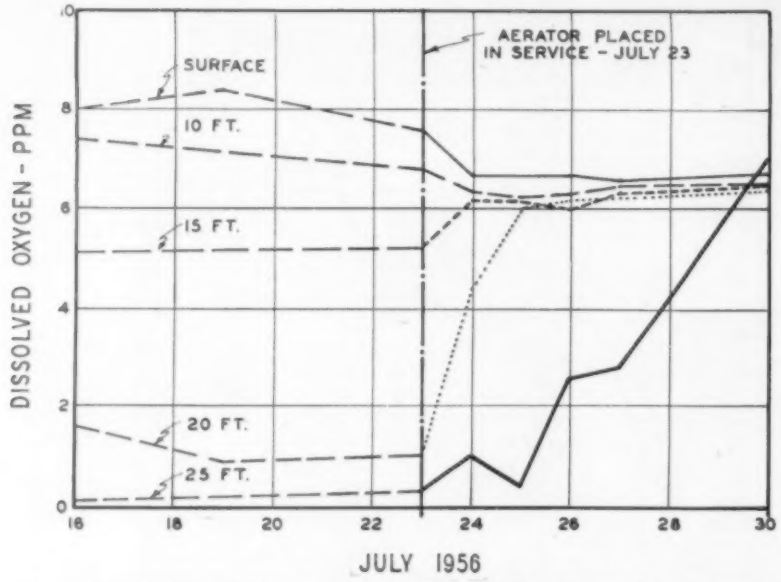


Fig. 6—DISSOLVED OXYGEN changes at sampling point No. 3 before and after placing aerator in service.

300 s.a.u. The same types, however, are still present. This reduction is probably due to removal of CO_2 from the bottom waters by aeration.

11. Crustacea such as *Cyclops* and *Diaptomus* have increased about fourfold. This may be due to a new biological balance being established, or more probably to the condition that aeration enables their existence at the bottom of the reservoir where there is a more ample food supply of bacteria and decaying organics.

12. Thermal relations have been quite interesting. Although all reservoirs in the Ossining area were frozen over in December, the Ossining reservoir had no ice cover except in the shallow third as late as mid-January. Water temperatures at Ossining during the cold spell of late December dropped from 39°F on December 24 to 32°F on January 3. From then until mid-January, when the aerator was shut down, temperatures ranged from 32° to 34.5°F. A rise of 2.5°F on a day of bright sunshine represents an input by sunlight of about 1,000,000,000 Btu. It seems quite probable that circulation can maintain reservoirs of this size in this latitude ice-free during winter. It is likely, however, that sunshine is of greater importance than temperatures *per se* in keeping circulating reservoirs ice-free.

Potential Applications

This type of aerator has a number of potential applications including the following:

1. For raising the natural alkalinity of water for the purpose of improving coagulation and retarding corrosion.

2. Iron, and probably manganese, can be precipitated from the zones of transition and stagnation by the maintenance of high oxygen saturation values throughout the entire depth of the reservoir.

3. If the aerator is operated only intermittently, it can serve a useful purpose in applying copper sulfate throughout the reservoir. It is also possible that alum can be applied for coagulation and clarification *in situ*, and chlorine for sterilization.

4. It is possible that floating aerators in long lengths (several thousand feet) can be effectively employed on large hydroelectric impoundments for breaking stratification and adding oxygen. For reservoirs of say 75-ft depth, the depth of submergence will probably have to be increased to 15 to 30 ft.

5. This type of aerator has a tremendous potential as an agent for introducing a continuous supply of oxygen at the air-water interface of large waste treatment lagoons where detention periods are from 1 to 10 days and depths from 5 to 10 ft. The maintenance of oxygenated bottom waters would seem to permit settlement and stabilization of suspended solids *in situ*.

6. The complete elimination of the zones of transition and stagnation, and the maintenance of a highly aerobic state in the liquid along the face of bottom sediments must create a biological environment differing appreciably from normal. Bacteria and higher forms of microorganisms operating in the facultative-anaerobic and anaerobic ranges will be inhibited, and aerobic types will prevail.

This biologic shift, however, seems to be on the side of safety, for nature tends to stabilize all decomposing organics first by aerobic action with the production of carbon dioxide as an end product. Indeed, nature's resistance against being forced into anaerobism is quite pronounced, else most of the bottom waters of storage reservoirs would be septic during many months of the years.

7. The effect of eliminating the zones of transition and stagnation on *Crustacea,* such as *Daphnia, Cyclops, Diaptomus* and *Bosmina;* and the effect on the fish population as a whole, cannot be evaluated at this time. From the standpoint of dissolved oxygen, bottom waters should become quite habitable, thereby increasing the reservoir volume ecologically suitable for fish culture. On the other hand, algae seem to be inhibited, and the effect on plant growth is unknown.

8. The freezing problem is one which experience and further study alone can evaluate. It seems possible to probable that the Ossining reservoir, if kept in a continuous state of circulation throughout the fall and winter months, would not freeze at the surface as was heretofore normal (icecaps have previously ranged from 8 to 16 in.) The resistance to freezing created by circulation, by solar energy, and by the bottom area, which tends to hold to an average, in this section, of 35°F, are enormous. These heat potentials (based on 80mg) expressed in Btu and equivalent tons of bituminous coal are as follows:

Condition	Heat to be Removed, Btu x 10⁶	Equivalent Tons of Bituminous Coal[1]	Carloads of Coal[2]
Lowering of temperature from 60° 39°F	14,000	560	12
Lowering of temperature from 39° to 32°F	4,670	187	4
Change from liquid to ice at 32°F	96,000	3,840	85

[1]At 12,500 Btu per pound and 25,000,000 Btu per ton.
[2]At 45 tons per car.

These values cannot be appraised for lack of suitable criteria, particularly the Btu potential of the bottom sediments. The problem would have intrigued Howard T. Barnes, who spent a lifetime studying freezing of lakes and rivers. It can only be said that there is undoubtedly an average winter temperature where complete

freezing of reservoirs would occur. The freezing of lagoons with depths of 8 to 10 ft requires careful study for each individual installation.

Other Benefits and Objectives

The primary object of the Ossining aerator was to enable the uniform and rapid application of lime direct to the reservoir, for the purpose of converting the hydrate to calcium bicarbonate with atmospheric carbon dioxide so as to maintain pH values of the incoming raw water (6.7 to 7.4) suitable for subsequent alum coagulation. Operating results showed that this was readily possible, and any desired degree of raw water alkalinity can now be maintained.

It is also possible that this can be effected with only one or two days of operation weekly, or one week monthly. At the outset it was realized, however, that if this could be done reaeration, or more specifically re-oxygenation, would also be effected, which from the standpoint of chemistry and biology of reservoirs, and biochemistry of waste lagoons, is much more significant than the mere application of a chemical.

Air Transfer

It is believed that forced aeration of large reservoirs or lagoons enables relatively high oxygen tranfer at relatively low cost. In the activated sludge process stress is placed on producing fairly small bubble size (consistent with satisfactory diffuser performance) on the theory that the greater bubble surface area enables a more efficient uptake of oxygen. Relatively little stress has been placed on water surface contact. Suffice it to say the combination of bubble area, plus surface area contact generally results in oxygen uptake efficiencies in the range of only 5 to 15%. A brief, albeit over-simplified, comparison will stress the point. Assuming an air input of 160 cfm in a conventionally designed activated sludge aeration basin,

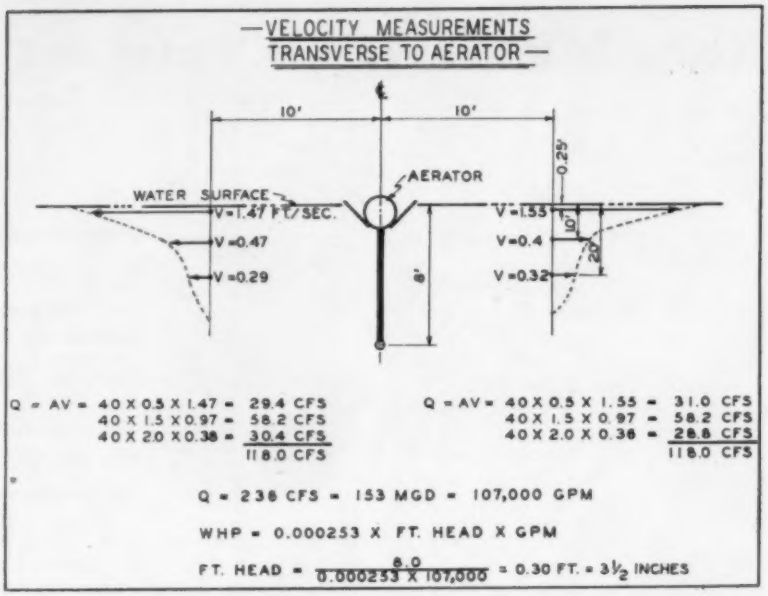

—VELOCITY MEASUREMENTS TRANSVERSE TO AERATOR—
10'
10'
AERATOR
WATER SURFACE
V=1.47 FT/SEC.
V=0.47
V=0.29
V=1.55
V=0.4
V=0.32
0.25'
10'
20'
8'
Q = AV = 40 X 0.5 X 1.47 = 29.4 CFS
40 X 1.5 X 0.97 = 58.2 CFS
40 X 2.0 X 0.38 = 30.4 CFS
118.0 CFS
Q = AV = 40 X 0.5 X 1.55 = 31.0 CFS
40 X 1.5 X 0.97 = 58.2 CFS
40 X 2.0 X 0.36 = 28.8 CFS
118.0 CFS
Q = 236 CFS = 153 MGD = 107,000 GPM
WHP = 0.000253 X FT. HEAD X GPM
FT. HEAD = 8.0 / 0.000253 X 107,000 = 0.30 FT. = 3½ INCHES

Fig. 7—VELOCITY and water movement induced by floating aerator.

results in 1,080 million bubbles per minute if bubble diameter averages 2 mm. These bubbles have a surface area of 146,000 sq. ft.

If the time of rise from the air releaser to the water surface is 3 seconds, the bubble area in submerged contact with the liquid at any time approximates 7,300 sq. ft as compared to the surface of about 800 sq ft for this type of aeration unit. It is obvious, therefore, that bubble surface area is about nine times water surface area, hence bubble size is highly important, and it is logical to assume that reaeration is to a great extent effected by the rising stream of bubbles.

At the Ossining installation, however, surface area approximates 800,000 sq ft, hence reverse condition prevails and water surface area is many times greater than bubble surface area.

For the two systems it may be stated, therefore, that total surface area (bubble surface area plus free water surface area) amounts to 8,100 sq ft for activated sludge basins, as contrasted to 807,000 sq ft. at Ossining. Thus, the increase in total air-water surface area is 100-fold.

This being the case, one may completely neglect the reaerating effect of the rising stream of bubbles and regard the aerator as simply a cheap, simple, and relatively efficient device for pumping very large quantities of water against veritably no head. Therefore, bubble size is strictly irrelevant, and the main function of the aerator is to expose a constantly renewed film of undersaturated water or liquid at the liquid surface of the basin.

How efficiently devices of the Ossining type function is a matter requiring many years of evaluation. But it seems safe to surmise that, on a horsepower applied basis, it is many times the efficiency of conventional methods of introducing oxygen.

Patents are now being applied for covering the aerator *per se* and the methods and purposes of this type of aeration.

Experts to Study Future Indianapolis Water Co. Needs

The Indianapolis Water Co., only a short time ago having completed its newest (Morse) reservoir is looking far into the future to the projected water needs of Indianapolis and its metropolitan area.

To make a study of future water needs and report on additional sources of supply Indianapolis Water Co. has retained a group of three experts. The basic study is to be made by the firm Alvord, Burdick and Howson of Chicago. The experts retained are L. R. Howson, S. B. Morris of Los Angeles, and Abel Wolman of Baltimore, all past-presidents of the American Water Works Association.

The firm Alvord, Burdick and Howson recently completed a study of water requirements for the Chicago Metropolitan area calling for an expenditure of something over $300,000,000. It also designed the extension to Indianapolis Water Co's. Whie River Filtration Plant as recently as 1953.

Mr. Morris is former Chief Engineer and General Manager of the Los Angeles Dept. of Water and Power which he continues to serve as consultant. Dr. Wolman is Professor of Sanitary Engineering at Johns Hopkins University and consultant to many municipalities and the State of Israel on its water undertakings.

Rate Making; For Water and Sewage Services

by ALBERT P. LEARNED

Mr. Learned for many years has been connected with Black & Veatch Engineers of Kansas City, Mo.

One of his specialties is utility rate making. In this article he discusses basic considerations in developing water rates that will make the utility self supporting at least.

RATE MAKING is primarily the science of conversion into a schedule of monthly, bi-monthly or quarterly prices for units of service or commodity, by which the cost of service is collected from the customer using such service or commodity. It is through rates that a proper financial remuneration is secured from the customer. Such remuneration is intended to equitably reflect the cost of providing the service or commodity for the customer's use and, in most instances, reflects the customer's demand, commodity and customer costs. Rate making—or better, its accomplishments—has been decidedly in the public eye during the last few years.

Municipal as well as private water utilities have found it imperative in recent years to ask for increases in the rate schedule to combat rising costs. These rising costs have included labor, supplies and other materials required to build, operate and maintain a water system.

Costs of all types have increased; consequently, an increase in rates is the normal result in water system operations, unless rates were inordinately high prior to the ending of World War II.

A change in living conditions has added to both the operating and fixed charges for water utilities. The use of the automobile has broken down the objection to distances in cities. The suburban movement has resulted in a lower number of customers in the closer in residential areas than in prior years. Increased costs for water service are due to larger lots per individual house, requiring more feet of pipe between customers. This, in turn, adds to pumping and storage problems, as well as investment problems.

Although this article deals primarily with water rate matters, other utility rate-making comparisons will be made to show similarities and differences.

Cost of Service Considerations

Rate making, as stated earlier, is the method developed to secure the revenues required to meet the cost of service. There are certain conditions that have a vital effect on the cost of service, and particularly so if all costs of service are met with operating revenues. The fundamental items of cost of service in a private or municipal operation must include in some form:

1. Operating and maintenance expenses.
2. Taxes or their equivalent.
3. Annual allowance for depreciation of plant.
4. Return on plant in service.

The private water utility faces all of these costs, and the municipality faces practically all of them in one form or another. The municipal utility should be expected to meet its operating and maintenance expenses. It may escape taxes due to statutory provisions, but more often it faces an equivalent cost in the furnishing of fire protection service, for which the municipality pays only a nominal amount or makes no payment. The municipal water utility should collect the annual allowance for depreciation of plant. If not, it will find it has used up its plant and has not the original dollars available to replace the plant as it becomes needed, nor its equivalent in added plant. As a general rule, the municipality as a whole has the ownership of the plant vested in it. Under such conditions, it can expect a return to pay interest on outstanding debt. If more than sufficient for that use income can also be used for the amortization of debt.

In too many municipal utilities it has been the practice in the past to fail to collect more than a token payment on the last three items of the cost of service. A part of this fault has been the result, in many instances, of payment of debt requirements by general taxation.

Municipalities have in recent years, due to retarded tax legislation in part, realized that they could not further finance a water utility by general obligation bonds or assume the payments for such bonds, nor have they been able to secure sufficient funds through the accumulations in the depreciation reserve to meet current plant, and main extension requirements. The water revenue bond financing has, in general, filled this breach on major projects. The requirements of the bankers for extra coverage of debt requirements on such bonds have been such that the funds actually raised through rates often reflect in that coverage sufficient funds to provide for depreciation and for interest on more plant than is reflected by the interest charge on current debt. Such excess coverage can be used for current extensions, an accumulation in the depreciation reserve account, or earlier retirement of debt.

Many municipal water utilities have coasted along in the years immediately following the ending of World War II and exhausted all excess capacity in the system. Then, suddenly they have been brought face to face with a major expansion program.

Water Utilities' Problems

In the establishment of a water rate, it is important to recognize that the investment per customer can be very high in a water utility. This is invariably the case where the production plant involves extremely high expenditures per customer. Examples of high plant costs, are found in our semi-arid section of the country, where water is conveyed for long distances and the expenditure for the amount of supply distributed is very high. On top of that, we have a situation in the water works utility field which normally is not experienced to as aggravated a degree by other utilities. For instance, the water utility's peak occurs normally in the hot, dry period of the year when the source

of supply, if surface developed, is normally at its low point. The period of this high consumption is relatively short, particularly in the northern areas and tapers off somewhat in the southern areas. Contrasted with the situation of the water utilities are the gas and electric utilities. The natural gas system, which invites space heating because of convenience and economy, would have, if one considered only the residential use, a peaking situation not unlike that experienced by the water utility. However, gas usage is normally spread over a longer period in the year, and the utility can build up its off-peak load by sales for commercial and industrial use for which there are no corresponding sales in the water works industry. The electric utility has diversified use and certain types of load result in a much more satisfactory annual load factor. For instance, there are certain types of load which do not occur in the summer in such extremes as in winter and vice versa.

In both the gas and electric utilities, the demand for the production is increasing more rapidly than in the water works industry. There are advantages in the gas and electric utilities, from the standpoint of delivery of the commodity or service, more favorable than those which exist in the water works industry. For example, in the electric utility (by the use of higher voltages), the same size wire can be used to deliver substantially larger amounts of energy. In the natural gas industry where one is dealing with a compressible material, the effect of stepping up the pressure to establish distribution in intermediate pressure systems results in a substantial saving in the investment used for such service.

In the case of the water utility, the water being non-compressible produces higher friction losses with increased velocities than occur with gaseous fluids. It must be recognized that the water utility, marketwise, does not have the advantages of either gas or electricity, nor does it have the advantages from an operating standpoint that is possessed by these other two utilities.

The expression that "water is free" has lead to many misunderstandings in water rate making because the public did not realize that the operational costs in the preparation of the water to make it fit for human consumption and for delivery to the customer involves substantial charges that must be spread over fewer units of consumption than are required in the gas and electric utilities.

Important Rate Considerations

One of the important considerations in a water rate schedule is that the monthly minimum be sufficient to carry a reasonable share of the total cost of service. The water works industry in the past has been inclined to have a low minimum charge and often has not realized that 20 to 40 per cent of bills in smaller cities show a usage of 0 to 2,000 gallons per month, and that approximately 65 per cent of the bills are for 5,000 gallons per month or less. In large cities where there are a number of multi-family residences, approximately 50 per cent of the bills will be for 7,000 gallons per month or less.

Another important point has been that cities have not realized that water works systems have two primary purposes-one to provide fire protection, and the second to furnish water to the customers on the system. They have failed to realize the fire protection feature of the system, although it does not use large quantities of water, does necessitate the building of pumping plants, mains, storage facilities, and hydrants to insure adequate fire protection when needed, and does comprise a substantial portion of the investment in plant.

Another important consideration, particularly from the standpoint of the ability of the customers to pay and the public relations of the department, is the fact that too often water use is billed for on a quarterly basis and seem high to the customers, especially during the summer period. They fail to realize that the bill covers a longer period of time and compare it with their other utility bills, which are rendered monthly. A peculiarity of the American public is that it finds itself able to pay more easily if billed monthly than if billed for longer periods of time. The public, to an unconscious degree, is a budgeteer of his available funds and is likely to dismiss from consideration obligations that occur more frequently. It is often stated that money is saved by the less frequent billing, but there is some question whether such extra cost of frequent billing might not result in easier collections and less irritation to the consumers, even though the customers paid slightly more to effect the more frequent collection of his charges.

There has arisen in recent years one important water supply problem; namely, the use of non-conserved, air-conditioning units, which are a wasteful seasonal addition to the season's peak requirements. Where such conditions have been recognized and a rate has been provided to meet the situation, the annual surcharge per ton of refrigeration for non-conserved units has varied from $12.50 to $40. The amount of such a load and its effect on system operations differs in localities and in accordance with weather conditions, but is a substantial threat to satisfactory water service during peak periods because of its quantity requirements.

A conserved air-conditioning unit installation does not present a serious problem, since its usage is approximately 1/20th of the usage of the non-conserved installation.

The water works industry faces another peak load in the summer; namely, sprinkling, which is a heavy increase but because of diversification and scheduling, if necessary, can be much better handled than a non-conserved air-conditioning situation.

Other important considerations in arriving at a water rate for a particular utility involves a realization of the average sales in thousands of gallons per mile of main, the average investment per customer, and the probability of necessity for further expansion of the system within the immediate future.

Sewage Service Rates

In the field of rate making, there has developed within recent years the problem of sewage service rates, or charges to make safe the spent water supply of the community which may be discharged into a stream where there is an inadequate volume of water to receive the waste without the creation of a nuisance or a menace to public health.

In the development of sewage disposal rates there must be some consideration given to both the biological oxygen demand of the sewage and its volume, which results in a fairly uniform charge for single-family residences.

Volume consideration enters in multi-family residences to reflect the additional load, and there must be consideration given certain industrial wastes, which add a substantial amount to the cost of operation and construction of the sewage disposal plants because of the strength of the sewage.

Summary

Rate making necessitates an understanding of the problems involved, the reduction of those problems into financial equivalents, and the equitable distribution of those financial equivalents among the customers of the system.

First Installment of

AWWA's 77th Convention Report

Meeting at Atlantic City honors retiring treasurer, W. W. Brush.

AMONG THE STROLLERS along Atlantic City's famed Boardwalk between May 12 and 17, were more than 3000 water works men, many of whom were accompanied by their wives. This was the annual convention of the American Water Works Association, where "fact, fellowship, and fun" were the order of the week.

The Convention

The convention proper, including both technical sessions and exhibits was held in the Auditorium, while the social functions were scheduled in various hotels. Fifteen scheduled technical sessions occupied the days from Monday morning to Thursday evening and there were dozens of committee meetings both scheduled and unscheduled, as well as diverse breakfasts and luncheons for special groups.

One hundred members of the Water & Sewage Works Manufacturers Assn. displayed their wares in 194 booths occupying 19,400 square feet of space. While this is the same number of exhibitors as at the St. Louis convention last year, the number of booths was greater by 12 and the booth space was greater by 3500 square feet.

The Social Calendar

As has been customary for the past several years, the "social whirl" began with a "Boardwalk Buffet" on Sunday evening at the Ambassador Hotel, followed by the usual evening of renewing acquaintances and making new ones.

Monday evening was occupied with the Awards Ceremony, a serenade by the Rutgers Glee Club and a reception and dance. Tuesday night offered more entertainment with songs from current Broadway musicals presented by members of St. John Terrel's famous Music Circus. Wednesday night held no planned entertainment in order to meet the popular demand for one night "on the town."

The annual banquet and dinner dance this year was dedicated to honoring William Whitlock (Bill) Brush, who retired as Treasurer of the Association after 35 years of service. Mr. Brush is also a past president of the Association.

Teas, luncheons, bridge, shopping, and "Boardwalking" entertained the ladies while the men were "at work" and the usual golf tournament was held for both men and ladies.

Past President
Paul Weir
Atlanta, Ga.

President
Fred Merryfield
Corralis, Ore.

Vice President
Lewis S. Finch
Indianapolis, Ind.

Treasurer
W. J. Orchard
Belleville, N. J.

Association Officers

New Officers Installed

The slate of officers nominated by the Board of Directors last January, having been declared duly elected to office on Mar. 1, were installed at the annual banquet.

President

Fred Merryfield
Professor of San. Engng.
Oregon State College
Corvallis, Oregon.

Vice President

Lewis S. Finch,
Vice Pres. and Chief. Engr.
Indianapolis Water Co.
Indianapolis, Ind.

Treasurer

William J. Orchard
Director
Wallace & Tiernan, Inc.
Belleville, N. J.

W. W. Brush, who retired as Treasurer, was named Treasurer Emeritus in honor of his long service. Harry E. Jordan continues as Secretary and Ray J. Faust as Exec. Asst. Secy.

Honors and Awards

Each year several members of the Association are singled out for recognition and honor, because of some distinctive service to the association or some outstanding accomplishment. Honor and awards are given in a number of categories. This year's awardees included the following.

Honorary Membership:

ALBERT E. BERRY, Director of Sanitary Engineering, Ontario Dept. of Health; "who is devoted to the advancement of engineered sanitation and whose leadership has been recognized by the Canadian members whom he has served for more than 25 years. A gracious gentlemen".

CHARLES H. CAPEN, Consulting Engineer, retired Chief Engr of the North Jersey District Water Supply Comm.; "one who has served competently and conscientiously in important engineering projects of great value to the users of the service provided."

S. LOGAN KERR, Consulting Engineer, The Logan Kerr Co., Inc.; "who is internationally recognized for his superior competence in the field of hydromechanics. Ever willing to serve in widening the general understanding of difficult hydraulic problems."

Treasurer Emeritus
W. W. Brush

Honorary Members

A. E. Berry | C. H. Capen | S. Logan Kerr | W. A. Kunigk

W. A. KUNIGK, retired Supt. and Chief Engr., Water Division, City of Tacoma, Washington; "who although of foreign birth, is imbued with the true pioneer spirit of the Northwest —self educated, devoted to the advancement of sound engineering throughout the Pacific Northwest and whose competence as an engineer has been widely recognized by professional society.

The John M. Diven Memorial Medal:

"To JOHN H. MURDOCH, JR., for his many contributions to the water works industry manifested by his provocative discussions of industry problems. His articulate presentations to the membership have stimulated thinking along constructive lines."

The John M. Goodell Prize:

To T. E. LARSON for his paper "Report on Loss in Carrying Capacity of Water Mains." as published in the November 1956 issue of JAWWA. "Dr. Larson's paper deals in a scholarly way with one of the most important problems in the entire water works industry and has high value to both the technology of the field and the literature of the field.

The Distribution Division Award:

To JACK W. MACKAY for his paper entitled "Development and Use of Specifications for Cast-Iron Pressure Pipe and Fittings". This paper published in the July 1956 issue of JAWWA, "records an understandable analysis of a series of standards of great importance to the water supply field.

The Management Division Award:

To LOUIS R. HOWSON, for his paper entitled, "Rates, Revenues and Rising Costs!" "This paper published in the July 1956 issue of JAWWA" is "another demonstration of the author's capacity to think clearly and express himself convincingly upon the basic problems of our industry."

The Purification Division Award:

To JOHN R. BAYLIS for his paper entitled "Seven Years of High Rate Filtration". This paper which appeared in the May 1956 issue of the JAWWA, "has great value in its demonstration of the propriety of revising certain long-held criteria in water treatment."

The Resources Division Award:

To WARREN J. KAUFMAN and GERALD T. ORLOB for their paper entitled "Measuring Ground Water Movement with Radioactive and Chemical Tracers". Published in the May 1956 issue of JAWWA, "this paper's great value lies in its critical analysis of the merits and deficiencies of the procedures studied. A forward looking study of an important problem".

The Harry E. Jordan Scholarship Award:

This year the committee decided to divide the award between two contestants—HERBERT H. HASSIS, a senior in Civil Engineering at Clarkson College, Potsdam, N. Y., who received $1000 and WILBERT H. SCHLIMMEYER, a senior in Sanitary Engineering at Rutgers University, who was awarded $500.

Secretary
H. E. Jordon

Association Secretaries
Exec. Asst. Secy.
R. J. Faust

Asst. Secy.
E. F. Johnson

J. H. Murdoch
(Diven Medal)

T. E. Larson
(Goodell Prize)

Awardees
J. W. MacKay
(Dist. Div.)

L. R. Howson
(Man. Div.)

J. R. Baylis
(Purif. Div.)

The Section Awards

The *Hill Cup* awarded for membership growth during the year went to the Indiana Section with a point score of 48.365; the Iowa Section was second and the Nebraska Section, third.

The *Henshaw Cup*, awarded to the section which has the highest percentage of its members in attendance at an annual meeting, went to the Cuban Section with an attendance record of 84.6 percent. The Rocky Mountain Section was second with 82.9 and the Montana Section third with a 64.8 percent attendance record.

The *Old Oaken Bucket*, emblematic of the largest sectional membership once more went to the California Section with 1349 members; the Southwest Section was second with 1058 members and New York third with 834 members. California has had the "Bucket" ever since it was placed in competition in 1939.

The George Warren Fuller Awards

Each year, the individual sections chose some member to be honored for service to that section. These are the Fuller Awards, presented at the AWWA annual meeting, each with a citation. Space does not permit the inclusion here of the citations, but the names of the awardees and their sections are as follows:

Jesse Lee Haley .....Ala.-Miss.
Robert Milner Cushing .....Ariz.
William Charles Welmon ....Calif.
A. Valentine DeLaPorte ....Canada
Ezra Bailey Whitman ..Chesapeake
Leandro De Goicoechea .....Cuba
Wylie Weeden Gillespie ...Florida
Horace Raymond Frye ....Illinois
Marshall Payne Crabill ....Indiana
Thomas Wesley Thorpe .....Iowa
Russell Louis Culp .....Kansas
Julian Roane Fleming ..Ky-Tenn.
Robert Letts McNamee ..Michigan
Ellsworth Lincoln Filby ..Missouri
Arthur D. Weston ..New England
George D. Norcom ....New Jersey
Reeves Newsome .....New York
W. W. Adkins ....North Carolina
Charles Edwin Beatty .....Ohio
A. Musgrave ..Pacific Northwest
John Huey Murdoch .Pennsylvania
William T. Linton ..Southeastern
J. Richard Pierce .....Southwest
William Ray Odor .....Virginia
James Earl Kerslake ....Wisconsin

Sections which made no award this year were Montana, Nebraska, North Central, Rocky Mountain and West Virginia.

New Directors

New directors elected to serve until 1960 include the following:

Burton S. Grant .....California
R. W. Haywood, Jr. ..Chesapeake
Laurence H. Daniel .....Cuba
Fred A. Eidsness .....Florida
H. H. Gerstein .....Illinois
David S. Thomas .....Montana
L. H. Coult .....North Central
Donald D. Heffelfinger .....Ohio
Karl F. Hoefle .....Southwest
Harvey S. Howe .....WSWMA

The second installment of this report on the 1957 AWWA Convention will appear in the next issue and will cover papers and reports presented at several of the technical sessions, as well as the new officers of the four divisions of the association.

J. A. Thomas, Roberts Filter Co. Vice Pres., is Dead

J. Albert Thomas, Vice President and General Manager of the Roberts Filter Manufacturing Co., Darby, Pa., died suddenly on April 11th. He was 54 years old.

Mr. Thomas was also Vice President of the Roberts Filter Co. of Canada, Ltd., in addition to being a Director of both companies.

Familiarly known as "Dick", Mr. Thomas was well known throughout this country and abroad for his many contributions to the development of major water works projects. He had been associated with the company for 40 years, and with its affiliate in Canada since its incorporation in 1930. During this period he served in many varied capacities, having been at one time purchasing agent, sales manager, and engineer. He became general manager in 1943 when he succeeded his brother, Charles Thomas, who died that year.

Mr. Thomas played an important part in the progress of the company in the consummation of many important water works projects throughout North America and Latin America, including numerous municipal, industrial, and Government jobs. He had been active in several water works associations.

Mr. Thomas was a member of the Engineers' Club of Philadelphia, The Union League of Philadelphia, and the Springhaven Country Club of Delaware County. He was a Mason, being a member of Chas. M. Swain Lodge No. 654, F and A.M.; a member of the Benjamin Franklin Con-

sistory, and LuLu Temple of the Shrine.

A life-long resident of Delaware County, he lived in Lansdowne, Pa. He is survived by his wife, the former Gladys Rice; a son, James Richard Thomas who is attending the Harvard Graduate School of Business; a sister, Mrs. Carlisle Reville; and a granddaughter.

New Way To Desalt Sea Water

According to Walter L. Picton, Dep. Dir., Water & Sewage Ind. & Util Div., Washington, D. C. the February 1 issue of "European Engineering," a private, semi-monthly report prepared by an American engineering staff in Zurich, Switzerland, carries the following article:

WATER PURIFICATION "The development of a new type of plastic, a special form of PTFE (polytetrafluorethylene), makes it possible to de-salt sea water by exposing it in these special plastic containers to sunlight. The plastic withstands exposure to sunlight and ultra-violet rays for periods up to ten years. A series of plastic stills—or salt-water containers—are being built to test the efficiency of the process in de-salting bulk quantities of sea water. The plastic containers will be 2 ft. wide by 100 ft. long and will cost less than $0.75 per 1,000 gallons capacity."

How to Save Face

If you want to, a sure way to save face is to keep the lower end of it closed.

The Causes of Tastes and Odors in Drinking Water*

by RICHARD D. HOAK

Dr. Hoak is Senior Fellow at the Mellon Institute in Pittsburgh, Penna. In this article he reports on the progress of a current study which discloses the complexity of the problem and points to natural substances as well as industrial wastes as causative factors.

WHEN PEOPLE COMPLAIN about a bad taste or odor in tap water their dissatisfaction often arises because of a difference from the flavor they have been accustomed to. Actually, the taste of water varies considerably from city to city. It is therefore a subjective measure of water quality, because potability and tastelessness are not synonymous. These considerations apply to moderate differences in flavor, for tastes and odors sometimes occur which are unpleasant by any criterion.

Twenty years ago Baylis said, "Microscopical organisms and decaying vegetation probably are responsible for more tastes and odors than any other cause." Nevertheless, it has been customary to blame industrial wastes for malflavors in water taken from streams subject to this kind of pollution. It is not unreasonable for waterworks operators to take this position, because there have been notable examples of taste and odor problems resulting from excessive discharge of waste from manufacturing plants. In recent years, however, there has been a trend back to Baylis' opinion. This has come about as a result of increasing knowledge of the contributions from algae, the Actinomycetes, decaying vegetation, and biological activity in streams.

Phenol Takes the Rap

Among the various constituents of industrial wastes, none has been as widely blamed as phenol for causing tastes and odors in water. This resulted from the finding that partial chlorination of low concentrations of phenol created an unpleasant medicinal odor. Inasmuch as chlorination is almost universally practiced at municipal waterworks, it was logical to assume that occurrences of medicinal odors were caused by phenol.

Development of a sensitive analytical method for phenolic substances was a significant factor in attributing medicinal tastes and odors to the presence of phenol. The distilled 4-aminoantipyrine method measures *all* substances which couple with the reagent to form a dye. Although it is generally recognized that the method is non-specific, it has become customary to report the results as phenol. This has led to the inference that whatever is determined by the method is actually phenol, and that such material must come from industrial wastes. It is now known that natural decay of vegetation produces phenolic substances, and that domestic sewage contains similar material. It is also known that partial chlorination of natural phenolics can cause medicinal taste and odor. These findings have stimulated research on the problem.

Many Substances are Odorous

The following classes of compounds are odorous: aliphatic and aromatic hydrocarbons, phenols, cresols, xylenols, lower fatty acids, esters aldehydes, ketones, aliphatic and aromatic amines, sulfides, mercaptans, heterocyclic compounds, and steroids. The odors of these compounds range from pleasant to nauseating, and characteristic odors vary with molecular alteration. Sometimes a minor change in structure will result in a pronounced change in odor.

The tendency for the odor characteristics of substances to alter with minor changes in structure is a complicating factor. Such changes undoubtedly occur in the biochemical dissimilation of substances in water. Therefore even if specific odorous compounds could be measured analytically, it might be difficult to determine the source of the original compound.

The striking differences in odor potential among a number of related compounds was shown by determination of their threshold concentrations in water. Table 1 lists the lowest perceptible concentrations of a group of phenolic compounds at 60° and 30°C.

The determinations in Table 1 were made at Mellon Institute as follows. A technician prepared solutions of the pure compounds in odor-free water made by percolating distilled water through a 4-foot column of activated carbon. He then made dilutions in glass-stoppered, 500-ml Erlenmyer flasks and heated them to temperature. The flasks were placed in random order before two to four persons in another room and the flask with the lowest perceptible odor was noted by each. The lowest concentration detected was listed as the threshold. The odor panel was given a flask of odor-free water for comparison.

TABLE 1

Odor Thresholds of Selected Phenolic Compounds

Substance	Threshold Conc., ppb	
	60°C	30°C
Phenol	5,000	10,000
o-Cresol	24	71
m-Cresol	100	333
p-Cresol	200	45.5
2,4-Dimethylphenol	100	55.5
2,5-Dimethylphenol	11	33
3,4-Dimethylphenol	5,000	5,000
3,5-Dimethylphenol	714	333
o-Chlorophenol	2.5	0.33
m-Chlorophenol	100	200
p-Chlorophenol	143	33
2,4-Dichlorophenol	6.5	0.65
2,5-Dichlorophenol	0.45	3.3
2,4,5-Trichlorophenol	333	11
2,4,6-Trichlorophenol	667	100
2,3,4,6-Tetrachlorophenol	47,000	915
Pentachlorophenol	12,000	857
1-Naphthol	455	500
2-Naphthol	5,000	3,333
Guaiacol	2.5	2

*Presented at the 11th Purdue Industrial Waste Conference and published here by permission.

It will be observed that some compounds apparently had a lower threshold concentration at 30° than at 60°. It would be expected that odor would become more noticeable as temperature increases, because odor perception is largely a function of volatility. The mechanism of olfaction is not well undertsood, however, and inconsistencies probably result from the fact that the human nose is not a particularly reliable analytical instrument. Nevertheless, the data show clearly the wide differences in odor potential among related compounds, and especially among isomers of the same compound.

Biochemical Activity in Streams

A stream is a complex chemical and biological medium in a state of dynamic equilibrium. An enormous variety of reactions occurrs constantly in streams, and all are in some degree dependent on each other. The biota of a stream ranges in gradually increasing complexity from single-celled bacteria and protozoa to fishes and highly organized aquatic animals. Food is essential to life, and, in the animal kingdom, at least, it is a general law of Nature that the more highly developed species feed upon those of simpler structure. Thus, there is a constant struggle for existence in streams, whereby any given organism preys upon life lower in the evolutionary scale, and, in turn, is devoured by more advanced creatures. Bacteria, which have the simplest structure of all stream organisms, must depend on non-living dissolved or suspended substances for their food supply.

Practically any organic substance can be used as food by bacteria, and these organisms, as a group, adapt themselves wonderfully well to the kinds of food available. Most bacteria have highly specialized functions, in that each variety can utilize a quite limited number of organic compounds, but the metabolic by-products of one species can become the food supply for another. This results from the enzyme systems peculiar to the various species. Exocellular enzymes fracture large molecules into units small enough to diffuse through the cell-wall of the organism. Once inside, endocellular enzymes convert the material into a source of energy, new cell substance, and by-products. The functions of particular enzymes are very specific and serve the special needs of the organism with which they are associated.

Natural Sources of Phenolic Compounds

Certain species of bacteria consume phenolic substances, whereas others produce them as metabolic by-products. This situation led to the supposition several years ago that there might be a "phenol" equilibrium in streams, brought about by a relative balance among "phenol" producers and consumers. Analysis of water from streams draining non-industrial watersheds has shown "phenol" concentrations in the range 3 to 20 ppb. These results do not necessarily confirm the hypothesis of a phenol equilibrium, but they do show that phenolic material can be present in streams containing no industrial waste.

Certain equatic plants release phenols. Water from an impoundment on the Gold Coast had an obnoxious odor following chlorination. Samples of the water were found to contain 310 to 960 ppb of phenols, and cold water extracts of plants in the reservoir had 200 to 1,200 ppb of phenol. When the reservoir was cleared of plants the odor problem disappeared.

Simple phenols have been found in raw domestic sewage in the range of 70 to more than 100 ppb. It is reported that sewage normally contains about ten times as much conjugated as simple phenols; these complex phenols probably are broken down into simple phenols by bacterial action in streams. It is interesting that the effluent from a trickling filter handling domestic sewage with no industrial waste was reported to carry 400 ppb of phenol.

The Steel Industry Committee of the Ohio River Valley Water Sanitation Commission conducted a phenol survey on the Monongahela and Ohio Rivers from August 17, 1953, to January 25, 1955. There were 19 sampling points stretching from Monessen, Pa., to Wheeling, W.Va., a distance of 112 stream miles. Weekly samples were composited from portions collected at two depths for each of four locations across the river at every sampling point. Normal discharge of phenolic material from all by-product coke plants in the sampled section was 4000 pounds per day, yet the survey showed loads ranging from 10,000 to 25,000 pounds per day for considerable periods of time. These figures indicate the magnitude of the load from sources other than coke plants. It is significant that "phenol" concentration, as well as the total load, increased with increases in runoff. This might indicate an increased rate of leaching phenols from decaying forest litter.

Production of Phenolics by Vegetal Fermentation

Several laboratory studies have been made to provide quantitative data on the production of phenolic material by decomposing vegetation. A typical experiment was carried out as follows.

Dried oak leaves were picked from trees and stored at 34°F in polyethylene bags until ready for use. A 5-gallon pyrex bottle was sterilized and 18 liters of heat-sterilized distilled water added. Dry oak leaves (180 g) were added and the bottle was aseptically closed with a stopper equipped with an air sterilizer to prevent contamination and to permit normal respiration during fermentation at room temperature. The stopper was pierced with a tube for periodic withdrawal of samples. These were analyzed for "phenol" by the distilled 4-aminoantipyrine method and for "tannin" by the Folin-Denis procedure. The analytical data are given in Table 2.

TABLE 2

Analytical Data on Oak-Leaf Infusion

Days*	pH	"Phenol," ppb	"Tannin," mg/l	Residue, mg/l TS†	Residue, mg/l DS‡	Color, ppm
5	5.3	209	90	1,012	963	1,600
12	5.1	272	92	1,079	1,077	2,600
15	5.0	271	120	1,081	1,079	2,200
19	4.9	307	138	1,076	1,073	2,200
22	5.0	281	136	1,078	1,059	1,800
27	5.1	283	144	1,103	1,088	2,200
34	5.2	278	151	1,133	1,133	2,200
40	5.2	281	162	1,123	1,125	2,200
47	5.0	265	170	1,147	1,128	2,200
55	5.2	267	—	1,226	1,204	2,200
62	5.3	239	179	—	—	—
68	5.3	242	178	1,257	1,200	2,200
75	5.5	239	180	—	1,228	2,200

*Days from start of infusion.
†Total solids.
‡Dissolved solids.

The "phenol" values were fairly constant, averaging 264 ppb, but they declined somewhat from a high of 307 ppb. The values for "tannin," which actually represent hydroxyphenyl groups, showed a steady increase. Considerable material went into solution rather quickly and the amount increased slowly. The infusion contained very little suspended matter.

Throughout the course of the experiment the infusion had a strong, disagreeable odor. At various stages the odor could be described as musty, pigpen, and sulfuretted. A qualitative test for hydrogen sulfide was negative, but this does not preclude the presence of sulfur compouds. At no time was there a medicinal or phenolic odor.

An obstacle to the study of odor-producing compounds generated by biological decomposition is the lack of analytical methods of suitable specificity. Various techniques are being used to provide clues to the composition of these complex solutions. Paper chromatography and gas-liquid partition chromatography show promise for quantitative exploration in this difficult field.

Qualitative paper chromatography had shown that phenol, *ortho-* and *meta*-cresol, and guaiacol (*ortho*-methoxy phenol) are present in the infusion. Table 1 shows that guaiacol is a very odorous compound. Gas chromatography techniques are now being developed to quantify this information.

The color of the original infusion was too high to make ultraviolet spectral transmission curves directly, and samples were prepared as follows. A 450-ml sample of infusion was taken on the 55th day. It was acidified with 10 per cent phosphoric acid to pH 4.0 and distilled. The clear distillate had a pH of 3.8. The remainder of the sample (400 ml) was treated with 100 g of sodium chloride and extracted serially with 50, 50, and 25 ml of diethyl ether. The ether extracts were combined and concentrated to about 45 ml under vacuum.

An ultraviolet spectrogram of the aqueous distillate showed no major absorption bands; this indicated that the concentration of any material in solution was below the sensitivity of the method. A transmission curve on the ether extract indicated that the phenolic material was largely *o-* or *m*-cresol (these compounds are not differentiated by the technique), and that small amounts of phenol or naphthol might have been present.

The ether extract was concentrated to about 2 ml and an infra-red spectrogram was made. This revealed the presence of the following functional groups: hydroxy (—OH) and/or amino (=NH); aliphatic(≅CH); carbonyl(=CO); methyl(—CH_3); and methylene (=CH_2). The carbonyl is an acid group representing carboxyl(—COOH). The phenyl, methyl, and hydroxy groups can be partially attributed to cresol, thus checking the ultraviolet spectrum and the paper chromatogram. The methylene, aliphatic, and carboxyl groups indicate the presence of aliphatic as well as aromatic compounds.

TABLE 3
Bacterial Population of Oak-Leaf Infusion

Days	Mean Total Count, ml
5	15,000,000
12	1,250,000
15	165,000
19	25,000
27	9,300
34	2,300
40	250
47	510
55	12,000
62	10,000
68	25,000
75	15,000

Total counts of bacteria were also made. Each value in Table 3 represents the mean of five dilution plates.

The rapid decline in population from the early high value, and the subsequent increase, cannot yet be explained adequately. It is likely that the first organisms subsisted on leaf protoplasm and decreased in numbers as that food supply became exhausted. It is possible that other strains then developed which could utilize tannin or lignin. Most of the organisms found appear to be aerobes or facultative aerobes; no strict anaerobes have been isolated. Purification of 93 isolations is in progress. Gram strains of 50 cultures revealed that Gram-negative rods and cocci are the predominant morphological types.

This experimental work provides conclusive evidence that considerable phenolic material is generated by decaying vegetation, and it suggests the conditions under which this might occur in Nature. The data also indicate that tannins, which contain two or more phenyl groups, may be precursors of phenolic compounds. An investigation of this aspect of the problem is planned.

Reaction of Phenols With Chlorine

A laboratory study was made to provide information on the reaction between phenol and chlorine, and to establish the conditions under which chlorophenol order occurs.

Chlorine-demand-free water was prepared by adding 2 ppm of chlorine and allowing the solution to stand for an hour. Any residual free chlorine was then destroyed by exposing the solution to ultraviolet radiation. Free available chlorine residuals were determined by the orthotolidine-sodium arsenite (OTA) method, using a Hellige Aqua Tester with a Chlorine I disk.

A stock solution of phenol was prepared by dissolving 1.000 g CP water-white phenol in distilled water and diluting to 1 liter in a volumetric flask. This solution was stored at 40°F.

Additions of chlorine water were made to a series of samples of water containing 100 ppb and 0 ppb of phenol in open beakers at room temperature. The pH of the solutions was adjusted to about 2 with sulfuric acid. The solutions were allowed to stand for three hours before measuring residual free available chlorine. The data are given in Table 4.

The 700-ppb sample was analyzed for phenol at the end of the contact

TABLE 4
Chlorine Residuals after Three Hours (1)

Initial Chlorine Conc., ppb	Initial Phenol Conc., ppb		Final pH
	100	0	
100	0	5	2.4
200	15	65	2.3
300	55	90	2.2
400	70	140	2.2
500	140	200	2.2
600	125	250	2.2
700	250	275	2.2
800	275	400	2.2
900	450	450	2.2
1,000	450	450	2.2

TABLE 5
Chlorine Residuals after Three Hours (2)

Initial Chlorine Conc., ppb	Initial Phenol Conc., ppb		Final pH
	100	0	
100	0	0	7.6
200	15	0	7.6
300	0	5	7.7
400	0	25	7.7
500	0	70	7.7
600	0	100	7.7
700	0	90	7.7
800	15	180	7.7
900	50	225	7.7
1,000	100	250	7.7

period; no phenol had reacted. This sample was chosen because the stoichiometric chlorine:phenol ratio is reported to be 7:1.

This experiment was repeated with solutions buffered to about pH 7.5 by adding 10 ml of saturated sodium bicarbonate solution to each. The data are given in Table 5.

Several of the foregoing solutions were tested for taste. The 200-ppb sample had a pronounced chlorophenol taste, but the 700-and 800-ppb samples had no taste. Tasting was done by comparing the samples with taste- and odor-free water prepared by percolating chlorine-demand-free water through a column of activated carbon. The 700-ppb sample gave a negative result with 4-aminoantipyrine.

In another experiment, 700-ppb of chlorine was added to chlorine-demand-free water containing 100 ppb of phenol and 20 ml per liter of saturated sodium bicarbonate solution. A distinct chlorophenol taste was detected after 10, 20, 30, 60 and 90 minutes, but the taste disappeared completely after three hours. The pH of the solution was 8.1.

These data indicate that (a) phenol does not react with chlorine at low pH values; (b) a chlorophenol taste may occur in distilled water with marginal chlorination at pH values above 7.7; and (c) phenol can be decomposed into tasteless by-products at pH values above 7.7 provided that at least the stoichiometric amount of chlorine is added and that a sufficiently long reaction time is allowed. These results were confirmed by duplication of the experiments. Failure of residual chlorine values in the controls to equal the amounts added to chlorine-demand-free water may be attributed to photosynthetic decomposition or to interferences with the analytical procedure. This effect should have cancelled out because all solutions were exposed to the same intensity of light.

Many of the conclusions that have been reached about the reaction between phenolic substances and chlorine have been based on laboratory studies with pure compounds. Rather different results are obtained when this reaction is investigated in the field.

Examination of operation reports from waterworks on the Monongahela and Ohio Rivers showed no correlation between phenol concentrations and medicinal (chlorophenol) tastes and odors in finished water. "Phenol" concentrations (as determined by 4-aminoantipyrine) above 200 ppb have been handled without medicinal taste occurring. On the other hand, medicinal odor was occasionally reported when "phenol" in the raw water was in the range 0 to 53 ppb. In general, waterworks operators reported phenol in the raw water almost daily, but only rarely had difficulty in producing water without a medicinal taste or odor.

The Youngstown Sheet and Tube Company and the Republic Steel Corporation have jointly sponsored an investigation of tastes and odors. In one phase of this study 17 samples of water from the Mahoning and Beaver Rivers were chlorinated marginally, and in excess of breakpoint. "Phenol" concentrations ranged from 2 to 1,710 ppb. A medicinal odor occurred in only one sample (650 ppb "phenol"), but the odor changed to musty at 50 dilutions. Odor thresholds increased on addition of chlorine to two samples; in the other cases they were reduced or remained the same.

These results contrast with widely accepted reports that chlorination of water containing 5 ppb of phenol will produce a chlorophenol odor. It seems evident that the material measured by 4-aminoantipyrine in natural water differs from the pure compounds used in laboratory investigations. In addition, data from various sources show that non-phenolic material causes tastes and odors in water. Identification of specific substances is quite difficult because of their very low concentrations, but progress is being made with some of the newer analytical techniques. Current research indicates that it is unwise to draw conclusions from laboratory findings until they have been tested in the field.

Dissimilation of Phenolic Substances

The persistence of dissolved organic matter in natural water is an important factor in fixing the responsibility for tastes and odors. A number of experiments was made to determine the rates at which various substances are biologically dissimilated in streams.

A sample of oak-leaf infusion was analyzed, using the full screening procedure for the 4-aminoantipyrine method given in the 10th Edition of "Standard Methods." The sample was analyzed for "tannin" by the Folin-Denis method. A 2.5-liter portion of the infusion was then mixed with an equal volume of freshly collected Monongahela River water and placed in a constant-temperature room (22°C). A solution of the same concentration of pure phenol in river water was prepared at the same time. Data on periodic samples are given in Table 6.

These data show that the "phenol" concentration trebled in 5½ days, then dropped sharply in the next three days. It is interesting that the "tannin" concentration decreased rapidly at first, then more slowly. This suggests that tannin may be a pre-

TABLE 6
Dissimilation of Phenolic Material (1)

Time, hr.	Temp., °C	Phenol Sol., ppb	Infusion Solution	
			"Phenol," ppb	"Tannin," mg/l
0	22	211.1	211.1	61.5
36	22	0	413.4	46.5
132	22	—	631.4	45.0
204	22	—	5.2	44.0
228	22	—	4.0	—
1,000	100		250	

TABLE 7
Dissimilation of Phenolic Material (2)

Time, hr.	Pure Phenol, ppb	Pure Phenol, ppb	Infusion ppb "Phenol"
0	41.	100.	41.
12	0	0	44.3
62	—	—	36.8
132	—	—	8.5
180	—	—	3.7

cursor for substances which couple with 4-aminoantipyrine.

The volatile phenolic fraction was separated from a sample of oak-leaf infusion as follows. The pH of the sample was raised to 11 with sodium hydroxide and the solution was boiled until the vapor failed to give an alkaline reaction with moistened indicator paper. It was cooled, 3 g of lead carbonate were added, and it was boiled for one minute. It was cooled below 50°C and enough sodium bicarbonate was added to bring the pH to about 8. It was distilled and the distillate analyzed by the 4-aminoantipyrine method; the analysis showed 82.0 ppb "phenol." A liter of the distillate was mixed with a liter of Monongahela River water. A portion of the same river water was used to prepare solutions containing 41 and 100 ppb of pure phenol. Periodic analyses are given in Table 7.

Solutions of Monongahela River water were prepared to contain 95 and 475 ppb of *m*-cresol, and 100 and 500 ppb of *o*-cresol. These solutions were stored at constant temperature (22°C). Analytical data are given in Table 8.

Analysis of a sample of raw sewage from a large Pittsburgh sewer showed 72.3 ppb of "phenol." Acid distillation with copper sulfate was the only screening procedure used. Two liters of sewage were mixed with an equal volume of Monongahela River water and incubated at 22°C. Analytical data are given in Table 9.

These experiments indicate that the rate of dissimilation of phenolic material in river water decreases as the substances become more complex. They suggest also that compounds which couple with aminoantipyrine are generated as complex organic matter decomposes. It is worth noting that phenolic material in domestic sewage and in an oak-leaf infusion dissimilate at about the same rate. It is not claimed that these laboratory studies represent what actually occurs in a flowing stream, but they show a pattern which helps to explain the presence of phenol from non-industrial sources.

TABLE 9
Dissimilation of "Phenol" in Sewage

Time, hr.	Temp., °C	"Phenol," ppb
0	22	36.1
12	22	30.9
58	22	14.9
108	22	5.6

Summary

This paper is a progress report on current study of the causes of tastes and odors in drinking water which discloses the complexity of the problem. Phenolic substances can cause malflavors under certain conditions, but many other substances can do so as well, and medicinal odors are not always due to industrial wastes. Identification of specific agents is a tedious analytical problem, but progress is being made with new techniques. Laboratory data on reactions between chlorine and phenols should be viewed with caution until tested in the field. The lack of correlation between phenol in raw water and odor problems at waterworks indicates that other substances are responsible for many water treatment problems.

Identification of the causes of tastes and odors is an exceedingly complicated problem which is slowly yielding to organized research. Proper corrective measures can be considered only after the causative substances have been labelled.

Acknowledgment

This paper is a contribution from the Multiple Fellowship the American Iron and Steel Institute has sustained at Mellon Institute since 1938.

TABLE 8
Dissimilation of Cresol

Time, hr.	Temp., °C	m-Cresol,* ppb		o-Cresol, † ppb	
0	22	95.0	475.0	100	500
16	22	20.4	385.8	54	485
40	22	0	235.3	9	406
64	22	—	—	0	328
112	22	—	0	—	—
136	22	—	—	—	8

*River Water pH 4.4.
†River Water pH 6.2.

Documentary Film By Concrete Pressure Pipe Assn.

"Lifelines For Civilization", a new documentary film over a year in the making, had its premier showing at the AWWA convention during the week of May 12, 1957, at Convention Hall, Atlantic City, N. J. The film which was specially produced for the American Concrete Pressure Pipe Association dramatizes the development of water supply systems down through the ages. Professional actors and authentic sets were created for the historical scenes. 16 mm prints of the film that has a running time of 20 minutes are available on loan for group showing. For information, write American Concrete Pressure Pipe Association, 228 N. LaSalle Street, Chicago 1, Illinois.

MADAM: standard connection or a itsy-bitsy connection, its still going to cost you $125.00.

What Do You Want In A Salesman?

by R. J. LEVEQUE

Mr. Leveque is Manager, Sales Services, Omega Machine Co., Division of B-I-F Industries, Inc., Providence, R. I. In this article he raises and discusses many thought-provoking points as to how the manufacturer's salesman can perform a most useful service to his customers.

IF YOU'VE been keeping abreast of the literature coming across your desk these days, you'll probably agree that "automation" is a pretty hot subject. We've been reading and hearing not only of factories, but also of water treatment plants, where they just push a button and machines do the rest. Despite certain claims to the contrary, no one as yet has perfected push-button selling. It still takes time—lots of it—to win friends and make customers.

We Must Have Understanding

Having made that statement, one cannot help but feel that the most appropriate drama in which salesmen can become engaged in their relationships with water works people is that of—understanding! In that light, it then becomes a matter of trying to understand each other's point of view; of trying to look at and solve problems in terms of benefits to both those who buy and to those who manufacture and sell.

It is no longer enough just to manufacture a better product, because technological advances enable one's competitors to build products just about as good. It is not enough for the salesman merely to tell you that his products are better than his competitor's. The mechanics of mass communication are also available to one's competitors, as are the mechanics of production. What, then, becomes the essential ingredient in the salesman's relationships with the buyer? Probably all will agree that it certainly isn't something that can be mechanized, automated, or fabricated from blueprints, or even a formula.

If asked to name that one essential ingredient unconsciously and perhaps without hesitation the answer would be "It is believableness." Or, as I like to say—"believability." You can feel its impact whenever you've listened to a salesman and are able to feel and say to yourself; "What he says, makes sense. I can't go wrong doing business with this fellow." Not until then does it become a belief that his product, or his service, or the man himself has a better value than his competition.

How To Win Friends and Make Customers

Yes, it still takes time—lots of it—to win friends and make customers. Notice that no statement was made that it still takes lots of time to make sales. Is there a difference between making a sale and making a customer? Certainly! A sale can be a spotty thing. Sometimes a sale is a one-shot affair, never repeated for one reason or another. A sale or a service on the basis of "Damn the torpedoes, full speed ahead!" puts no customers on the books. As such, this type of sale usually becomes a mere statistic. But a customer isn't a statistic. He's you, he's me—with feelings, emotions, biases, prejudices, and wants to be satisfied.

If in salesman-customer relations together, these things are recognized and are dealt with accordingly, salesmen then are faced with the fact that a customer isn't someone with whom to argue and match wits. Nor is the salesman an interruption of the customer's work; rather, he is the purpose of it. If I may paraphrase the title of a popular movie of last year, I'd say: "A Customer is a Many-Splendored Thing." Why? Because customers repeat—which is what makes them customers.

Yes, there is a difference between making a sale and making a customer. This brings up the question: "How then does one create customers and not just make sales?" To develop a satisfactory answer to that question it seems logical to try to rephrase the question, if possible, from the standpoint of a water works operator.

What Do You Want In A Salesman?

If the situation has been interpreted correctly, then water works people might well be asking themselves the question: "What do I want in a salesman?" From my own 15 years of experience as a filter plant superintendent and 13 years as a manufacturer's sales manager, I would say:

1. Give me a salesman who has a thorough knowledge of the product and service he's selling, and who has at least made some effort to analyze my needs.
2. Give me a salesman who tempers his enthusiasm with truth and common sense.
3. Give me a salesman who won't be content until he knows I'm satisfied with the equipment he's sold me; who makes sure I'm using it in a way to get the best from it and to derive the benefits which formed the basis on which the sale was made.
4. Give me a salesman who has the courage to lose my order and forego the immediate profit if, in so doing, he has won my respect.
5. Give me a salesman who is dependable so that, when he makes a promise, I know he will follow through on it.
6. And, finally, give me a salesman who, when making a routine call, will

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"There is a big difference between making a sale and making a customer . . . . A customer is not someone with whom to argue or match wits; he is a 'many splendored thing'."

be considerate of my time and, unless he has something specific which will be of interest or of help to me, will make his visit brief.

In summing up, the substance of what has been said is that selling is helping: helping by sincerely putting ourselves as salesmen in the water works man's place, by thinking as with his mind, and by seeing as though we had his eyes. It means the ability to forget one's self—sometimes a difficult thing to do, but a necessary characteristic of a good salesman.

The fundamental job of the salesman is to establish a feeling of confidence between the operators, superintendents and engineers and himself as a salesman. And until someone perfects push-button selling, it still is going to take time—lots of it—to make friends and win customers.

The Water Works Engineer And the Salesman

by WALKER H. GRAVES

Mr. Graves was Director of Water, Light and Streets in Martinsville, Va. at the time this article was written. Since then he has established his own business, Graves Supply Co., Inc., in Martinsville.

THERE ARE as many different techniques in selling as there are salesmen. A great many of these depend on the products involved; however, this discussion is confined to the individual who has a product that could or should be used in the water works field.

When a water works engineer recognizes a particular product as one that is made and distributed by a reputable company, his first thought concernnig the salesman is that the man should be as dependable as the product he sells. The converse of this is al:o true. The engineer may not be familiar with the particular product, but if the salesman has proven over the years to be dependable, the engineer doesn't mind taking a chance on the new product.

Often a salesman will let his enthusiasm run rampant and will make claims for a product that neither the designer, nor the manufacturer, nor the distributor will back up. Just because the salesman gets carried away, however, does not relieve the company, in the eyes of water works men, because to them the salesman is the company and vice versa.

Repeat Sales Make Business

A salesman should be one of the first to recognize the fact that neither he nor his company can survive on a "one-shot" sale. In other words, he will make his name and his profits on repeat business and to do that, he must play all of his cards aboveboard with his prospects. He must not deviate one iota from what he knows his product will do and when it can be delivered.

If a salesman gains the reputation of being dependable, his battle is 75 percent won. But once he makes claims that cannot be met and is proven to be one who is prone to exaggerate, he must face an almost insurmountable barrier to re-build the confidence of the water works engineer. He need not be an engineer himself to be of service to his company and the water works man, but he must know to draw the line on making rash promises.

Many times, the water works engineer knows what he needs to accomplish, but equally as often he is not at all sure whether the product he has in mind will do the job. Consequently, the salesman must be in a position to adequately describe his product, with its limitations as well as its advantages. Some products will do a fine job if they are used as they were intended, but will be a constant source of trouble for the water works engineer as well as the company if they are used incorrectly.

One of the more important relationships between the water works engineer and the salesman is the firm belief on the part of the water works engineer that his *salesman friend* can give him a complete and correct application for the product involved. Many salesmen fall down on this point. They are so eager to make the sale that they will sometimes recommend an item to do a job that is far removed from the intended application. When this happens, too many times only a mediocre job is done instead of a superb job.

The salesman isn't entirely to blame for this situation, because in many cases the engineer doesn't give him all the details; and unless the salesman is completely familiar with his product he will be unable to question the water works man to get all the necessary data. He should feel he knows his product so well that even if he has to recommend against its use for a particular application, he can do so in the true spirit of being helpful to his prospects. In any case, he should never be embarrassed to say he will check with the factory to be doubly sure of his product before making a recommendation.

Integrity Above All

The author recalls one salesman who was forced to turn down a rather large order because he knew his product wouldn't do all that the engineer expected of it for the particular application. In turning down the order he took great pains to explain why his product would not be as good as his competitor's for this application. Although he lost this order, he gained the confidence of the engineer to the point that he sold another one several times as big when the specifications were such that his product would adequately take care of the situation.

Ed. Note: This paper was prepared and read as a companion presentation to that by R. J. Leveque, at the Virginia Sect. AWWA and was released for publication in *Water & Sewage Works.*

To be helpful and sincere is to build future business and everyone should be looking for that in addition to the current market.

Service Part of Sale

While on the subject of helpfulness, another very vital connection between the two is that of service. This covers a vast field-from service in the form of advice to that of chucking out equipment and seeing that the engineer gets all that is desired or deserved from the product. Many times the salesman erroneously takes the attitude that once he has the prospect's name on the dotted line and the product is delivered, his task is completed until the need for additional merchandise is at hand. No bigger falsehood was ever conceived.

As stated earlier, the salesman is the company in the eyes of the engineer; and if the engineer can't go to the salesman to get the desired service he does not feel that he is getting his money's worth. Many items on the market today will possibly do a creditable job in a particular application, the only difference being that one salesman will offer service as part of his deal where another will not. This should not be interpreted to mean that the engineer is expecting the impossible or that he wants a lifetime guarantee. That isn't what is meant. This discussion is referring to the ability to get help when it is needed, and the cost may not be an object. Service, again, is a big word and should be explored from many angles where the relationship between the water works engineer and the salesman is concerned.

The mails and the telephone have done wonders to help water works engineers get adequate coverage from the factories. Therefore, in most instances the salesman should consider himself much more than a transmitting agent. If the salesman has cemented his relationship in the items mentioned earlier, the order transmittal will take care of itself.

The salesman may be many miles away when the need arises or when the deal is finally consumated; he may have spent weeks or months preparing the way. But he is no less responsible for the order, whether received with his name attached or by letter or phone, and the factory or company he represents should see that he gets the credit for it. Occasionally a salesman will use the approach that if he doesn't send the order in directly he does not get the credit for it. When that situation arises in my office, I immediately wonder whether the company or the salesman is at fault. It puts me in a defensive position, which tends to destroy any feeling of good will or confidence regarding the salesman, the product, or the company. There may be cases where this approach is absolutely necessary, but I doubt it.

Good Relations Required

Today the word "psychology" is used more than ever before. It is discussed in connection with how to handle one's children, one's wife, and one's employees. But probably no one group needs to use it more than the salesman. Possbily from his company's standpoint that might be high up on the list of his qualifications; it certainly is high up on the list of qualifications from the standpoint of relations with the water works man. Too often a salesman has thwarted his chances on a prospect by not using psychology or his knowledge of human nature; or as the old folks used to say, plain ordinary common horse sense.

Don't Waste Prospect's Time

Most of the time the water works engineer has or can take a little time to be courteous, even though he may not have a thing on his mind, as far as this salesman is concerned, for this visit. But when a salesman over-extend his stay, he is building a stone wall between himself and his prospect that will become more and more difficult to overcome. He will find it increasingly more difficult to get the engineer cornered, and in many instances he will literally lose his contact. One of the high priority items on the salesman's list of "do's" and "dont's" should be to give the proper respect to the engineer's time. If he is a close observer, he will learn mighty early when a water works man has some time to kill and wants to visit and when he is "snowed under" and would enjoy being left alone.

Some salesmen make it a practice to open an interview with a question about the time the prospect may have. If it is phrased properly, it will give the engineer a chance to politely excuse himself for this time or to allow all the the time necessary for the salesman.

If the engineer needs to be doing something else at the time, he isn't going to hear the salesman "pitch" anyway. This is where a good solid friendly relationship can help. Once it is built up the engineer would not feel awkward in telling the salesman pointblank that he is extremely busy and will see him next trip. Under such relationship, the salesman would take no offense at such a proposal.

Contrary to the old belief that a salesman should use persistance, I feel he should lean over backwards to keep from appearing to do so. Today as never before, water works engineers are in no mood for high-pressure salesmanship. They weigh the facts and figures and they want to know that the man who calls on them can give complete information without writing a book-length novel.

There is another very important point concerning the relationship. After a salesman has given all the information concerning his product to the engineer and the request for bids has gone out, regardless of how important the sales is to the salesman, he certainly should not come back and tell the engineer what a horrible mistake has been made in not accepting his product over another. It would seem that any fool would know that, but it has been known to happen.

If the engineer is conscientious at all, he is going to attempt to evaluate the product not on price alone, but also on all phases. He may well make a mistake in his judgment, but there is nothing to be gained by the salesman in telling him he is a "chump." It is better to accept his judgment gracefully; if he has made a mistake in choosing the product he certainly will scrutinize the choice more carefully the next time, and undoubtedly give the alternate products more consideration. A good loser is just as important as a good winner in sales as well as sports.

The relationship between the water works engineer and the salesman is as fundamental as life itself. No engineer is perfect: no salesman is perfect. But if the proper attitude is present between them, they can help each other do superb jobs for the public, the one ultimately served.

No amount of literature can take the place of a timely visit from a well-informed, dependable salesman. The salesman should use his time to build up a solid friendly basis for discussion of the product involved.

In conclusion, the water works engineer needs and wants the help of the salesman and certainly the reverse is true. With the proper relationship, all manner of things can be accomplished.

Story of the "Rockwell Report"

Proof that Institutional Advertising has merit

The story of the "Rockwell Report" is one of the most intriguing stories in corporate industrial advertising.

It runs counter to most of the pre-conceived notions about successful advertising, yet it continues to score higher and higher readership ratings year after year. Invariably, it ranks among the "most read" ads in readership studies of publications where the Rockwell Report appears.

This happens in spite of the fact that all Rockwell Reports "look alike." And in spite of the fact that the Rockwell Report is "all type."

Although these qualities may be weaknesses in the eyes of some, the Rockwell agency—Marsteller, Rickard, Gebhardt and Reed, Inc.—believes they are among the "strengths" behind the success of the Rockwell advertising program. The "look alike" feature has established identification—readers look for Rockwell Reports just as they look for the work of a favorite columnist. The "look alike" aspect makes it easier to find.

Insofar as the "all type" comment is concerned, the Marsteller-Rickard people believe people will read any reasonable volume of text so long as it is informative and interesting. Making the Rockwell Report adhere to those standards over a six-year period has been a goal of both client and agency.

Objectives Unchanged

The original objectives of the program still prevail, and it is believed that excellent results already have been obtained in line with them. The objectives and some of the results in which the Rockwell Report program undoubtedly figure are:

1. *To inform security analysts, investors and the community.*

When the campaign started, Rockwell had about 750 stockholders. Today there are approximately 12,000 stockholders. It is the company's preference to keep Rockwell stock on over-the-counter basis, but it is more actively traded than about three-quarters of the shares listed on the New York Stock Exchange.

2. *To acquaint the public with the management picture at Rockwell.*

The picture and by-line of W. F. Rockwell, Jr., personalize the Reports which deal with business subjects in an unusually explicit and non-technical style. Over-all, the advertisements deal with plants, products, personnel, methods, community and public relations, with consistent references to Rockwell's pattern of diversification and technical leadership. As a result, Rockwell's files disclose hundreds of letters a year from the U. S. and a score of foreign countries, commenting and seeking additional information. The letters come from the heads and executives of corporations and business concerns; university presidents, deans and faculty members; officials of trade associations, professional societies and chambers of commerce, among others.

3. *To acquaint the public with Rockwell's corporate character.*

The Reports are a powerful medium for identifying Rockwell Manufacturing Co. as a growing and well-managed enterprise. Mr. Rockwell is frequently complimented for the "frankness' of his comments and for the timeliness with which he deals with subjects of current interest. The Rockwell Report format and style have proved adaptable to other communications activities as well: the "Rockwell Report to Shareholders" and plant community newspaper ads signed by the general manager of local plants.

4. *To publicize the many products of Rockwell and their fields of application.*

The ads enable the company to bracket references to divisional products with the Rockwell name so as to present a broad picture of products and markets. Recently a Rotary club in Lyndonville, Vermont, requested films on gas and water meters mentioned in a Rockwell Report. A power tool customer wrote to say that small companies benefit from the suggestions on management included in the series, and recalled how the Delta Power Tool Division had given him good advice when he was starting his business.

A "Rockwell Report" in the making

Left to right, W. F. Rockwell, Jr., president, Rockwell Manufacturing Co.; W. F. Weimer, advertising manager, Rockwell Manufacturing Co., and Norton Weber, vice president, Marsteller, Rickard, Gebhardt and Reed, Inc., the advertising agency.

Results of the "Rockwell Reports"

Rockwell management is personalized by the series, and W. F. Rockwell, Jr. personally receives such a consistent response that he and his associates are convinced of the values inherent in a consistent "reporting" job.

Top management interest at Rockwell is evidenced by the way the series is developed: about three or four times a year meetings are held to discuss subject matter for the next several Rockwell Reports. Included in the meeting group are Mr. Rockwell; L. A. Dixon, executive vice president; W. F. Weimer, advertising manager of the company; Norton Weber, vice president, Marsteller, Rickard, Gebhardt and Reed, Inc., the advertising account executive; W. A. Marsteller, the over-all account supervisor and originator of the idea.

Subjects for "lead" articles in the columns are selected by Mr. Rockwell himself, and he also plays a leading part in suggesting possible story material. Week after week he gets a good size stack of mail agreeing, disagreeing or asking for more information, permission to use his material for one or another purpose.

Ed. Note: Reading of the success of the "Rockwell Reports" in the N. Y. Times, and thinking that our readers would find it of interest, this "Story of the Rockwell Report" has been written for *Water & Sewage Works* by Harold Burson, president of Burson-Marsteller Associates of New York.

A Report on—
NEWWA's March Meeting*

Water Works School, Superintendents' Round Table, Chemists' Round Table

Spring arrived in Boston on the afternoon of March 20 and with it arrived several inches of snow, which was still in evidence the following day when the New England Water Works Assn. held its regular monthly meeting in the Hotel Statler. Under these adverse conditions the normal attendance of 225 or so was cut to approximately 180.

President
Ed. L. Tracy

Secretary
Jos. A. Knox

Water Works School

As is customary, the meeting opened with "The Water Works School". This session was devoted to the subject of SURGE IN PIPE LINES presented by Dr. Donald R. F. Harleman, Assoc. Prof., Mass. Inst. Tech., Cambridge, Mass.

Prof. Harleman referred to a previous lecture on water hammer, in which he had pointed out that the pressure wave travels at the rate of 4000 ft per sec. In his March lecture, he discussed a different type of pressure wave and the use of surge tanks on conduits or transmission lines. In such a system where the surge tank is open to the air, closing a valve on the line, below the surge tank will cause surges which travel quite slowly (compared to water hammer pressure waves), and last for some considerable period of time. In fact, it requires four periods of surge to reduce the amount of surge effect by half and these periods may last several minutes each.

Dr. Harleman explained the relation of the first surge to the velocity of flow, length and diameter of pipe, and diameter of surge tank. He also discussed the relation of oscillation period to these same factors. As an example of a system where surge tanks are employed, Dr. Harleman mentioned hydroelectric generator systems. There are also some situations in water supply where surge tanks have applications.

Superintendents' Round Table

Public Relations was the subject of a panel discussion, with particular reference to "THE SUPERINTENDENTS' RESPONSIBILITY TO THE ADMINISTRATION AND THE CONSUMER." Three men participated: John B. Kennedy, City Manager, Medford, Mass.; Kenneth W. Robie, Supt., Water Dept., Brookline, Mass.; and Chester Spielvogel, Southbridge Water Co., Southbridge, Mass.

Mr. Kennedy, who is a former water superintendent and now a city manager, spoke with a knowledge of both aspects of public relations. He also referred to his father who had been a water superintendent in Winthrop, Mass. From his father, he had learned to "run the water department with a good, honest, straight-forward policy," because people, both the administration and the customers, respect men who are "right guys".

According to Mr. Kennedy, a superintendent knows his business better than any politician or administrator; it's his business to know. He should never be afraid of the administration but should keep them advised at all times of the facts they should know.

Mr. Robie, who represented the viewpoint of a superintendent in a municipally owned plant, pointed out the importance of the meter reader in good customer (public) relations. Meter readers are the principal personal contact of the customer with the water department; they should be ambassadors of goodwill. Mr. Robie gave examples of good and bag meter readers and what they do.

When it comes to complaints about water usage, Mr. Robie has found the "Meter Master" to be a big help in showing the customer just how he uses water. In Brookline, they have two service men who investigate and act on complaints. These men, too, are important to good public relations.

Other practices which improve public relations are: Advise customers by card when a shut off is planned; invite school classes to inspect the system and plant; have a supply of A.W.W.A. "comic books" on the story of water supply and give these to visitors; speak to service clubs and other organizations whenever possible and pass out the A.W.W.A. story book on water.

Programmers
E. S. Chase C. I. Sterling

Mr. Robie suggested that the municipal budget committee should be invited for a personally conducted tour of the water department. He also told how a rate increase drew only 12 complaints because of foresightedness in sending an explanation to all customers before the increase went into effect.

Mr. Spielvogel represented the viewpoint of the superintendent of a private water company. He has the problem of public relations with consumers and stockholders. Although his company is privately owned, he believes that the public is the "boss" and must be satisfied.

According to Mr. Spielvogel, it is important to provide an adequate water supply to all customers, and it is important to keep the public informed at all times. He believes that the use of the round dial meter is a disservice to the public, and he thinks meters should read in gallons—not in cubic feet, because the public can understand how much a gallon is.

Mr. Spielvogel also emphasized the

*This report was prepared for publication in the May issue, but had to be delayed until this issue because of lack of space.

importance of the meter reader to good public relations (as had Mr. Robie) and added that the clerks in the office likewise were important contacts with the public. He said, too, that it is important to treat all customers alike, especially delinquent accounts. At the end of 1956 he had only $4.96 in unpaid accounts and he has only shut off two customers in 8 years. These facts are evidence of both his fairness and good public relations.

Rate raises for private companies are subject to approval of the Dept. of Public Utilities. Mr. Spielvogel has had no difficulties with the Mass. D.P.U., either in requests for rate increases or handling complaints; more evidence that good public relations pays off.

Mr. Spielvogel reminded the audience of one of the tenents of Rotary International, which says, "Service above self" and he said that for the private water company this could be translated into "he profits most who serves best."

Chemists' Round Table

"Oxygen Demand Exerted by Leaves Stored Under Water" was the topic presented by E. Sherman Chase and A. F. Ferullo of Metcalf & Eddy, Cons. Engrs., Boston.

It has long been known that leaves in reservoirs exert an oxygen demand on water as well as imparting color, and sometimes tastes and odors. In an effort to determine the extent of this oxygen demand, the authors studied the effect of so-called "natural pollution" in a series of laboratory tests.

The authors described the tests and results obtained, which indicated that maple leaves have an oxygen demand equivalent to 75 percent of their weight. Oak leaves and pine needles have an oxygen demand of only 50 percent of their weight in a year's time. Considering temperature variations in reservoir and ponds, these oxygen demand values may be high for natural conditions but they do indicate an important factor in reservoir control and operation.

Water Resources

Following the luncheon, the subject of water resources in Massachusetts was discussed by two speakers. Francis W. Sargeant, Commissioner, Mass. Dept. of Natural Resources, talked about "Water and Its Importance in a Resource Development Program," Clarence I. Sterling, Jr., Engineering Consultant, Mass. Water Resources Commission, outlined "A Water Resource Program for Massachusetts".

Mr. Sterling who is also Chief Engineer of the State Board of Health, spoke of multi-purpose reservoirs and the great ponds of the state. There is not enough ground water in Massachusetts, and therefore surface water must be used for water supply. Of the 1500 great ponds in the state, only 10 percent are now used for water supply, but more will have to be used in the future.

At present 3.1 per cent of the state's area is held for the protection of great ponds for water supply. Bathing is not allowed in these ponds but in some boating and picnicking is allowed. In the future, the state may have to let down the bars and allow recreation on these ponds providing the water supply is treated before distribution.

The work of the Water Resources Commission includes:

Coordination of the work of state agencies

Act as a clearing house for basic water data

Review existing laws and policies and develop policy

Advise the state legislature on the allocation of water resources

Act as coordinating agency for the Commonwealth with Federal agencies

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"Steve" Casteel Retires

Long-Time Manager E. St. Louis Water Co. Succeeded by F. J. McAndrew

Stephen C. Casteel, general manager of the East St. Louis and Interurban Water Co. for the past several years, retired April 1, 1957. He is establishnig an office in East St. Louis and will offer a consulting and advisory service to water utilities in matters of management and operation.

A native of Hannibal, Mo. his first job was with the Keokuk Electric Co. of Keokuk, La. Later, 1920-1930, he served as construction engineer for Sanderson & Porter, Engineers, and West Penn Power Co. In 1930 he became associated with the Am. Water Works Co., as construction engineer and had charge of construction of a number of A.W.W.Co. plants, including those at Birmingham, Ala.; Pittsburgh, Pa. and Havana, Cuba.

In 1934 he transferred to A.W.W.-Co's operating division, serving as engineer of pumping at Little Rock, Ark. and later as engineer in charge of pumping and purification at Davenport, Ia. Since 1941 Mr. Casteel has been connected with the East St. Louis Water Co. as resident engineer, assistant manager and since 1953 was general manager.

Mr. Casteel is a registered professional engineer of Illinois and is a past-president of The National Assoc. of Power Engineers, the St. Clair County Chapter of Professional Engineers. He has written and presented a number of technical and management papers before the Am. Water Works Association and other professional societies.

A leader in civic undertakings, Mr. Casteel has been a member of numerous state and local Chamber of Commerce committees as a past-president of the Chamber of Commerce of East St. Louis; past-chairman of the Am. Red Cross Drive; past-president of the Kiwanis Club of East St. Louis.

Mr. Casteel, too active to retire except under mandatory retirement, expects to continue being active by establishing an office and offering consulting services in management and operation of water companies and water departments. He also plans to do some writing for publication, the first of his articles being scheduled for an early issue of this magazine.

Mr. Casteel is being succeeded by Frank J. McAndrew, manager of the St. Joseph (Mo.) Water Co. Mr. McAndrew, in turn, is being succeeded by E. C. Smith, assistant manager of the Birmingham (Ala.) water works, now municipally owned.

Politics

Politics may make for strange bedfellows, but they soon get accustomed to the same "bunk."

Centrifugal Pumps Can't Read!

Their selection for the specific job is important

by J. A. CABLE
Application Engineer
Centrifugal Pump Dept.
Allis-Chalmers Mfg. Co.

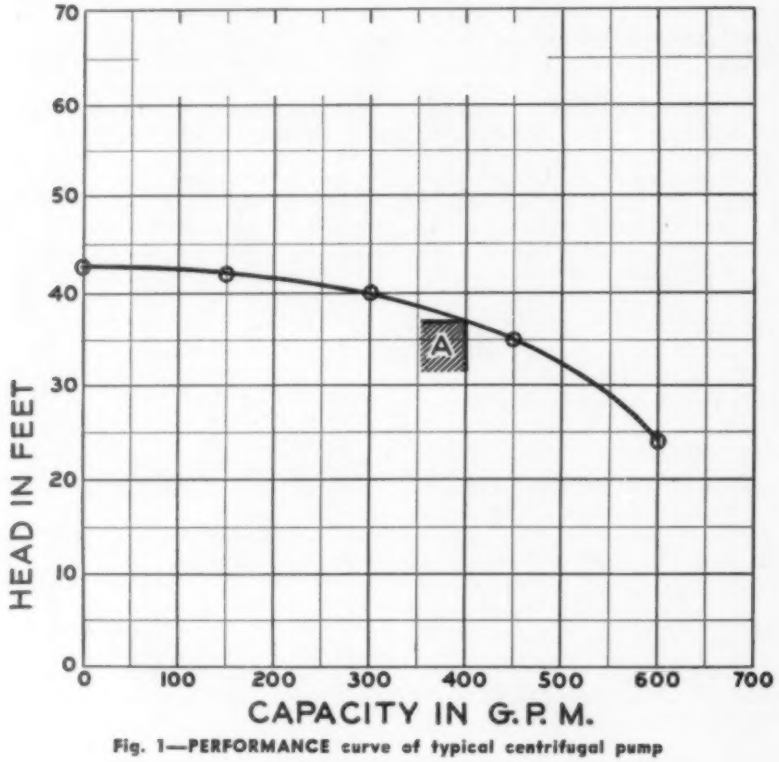


Fig. 1—PERFORMANCE curve of typical centrifugal pump

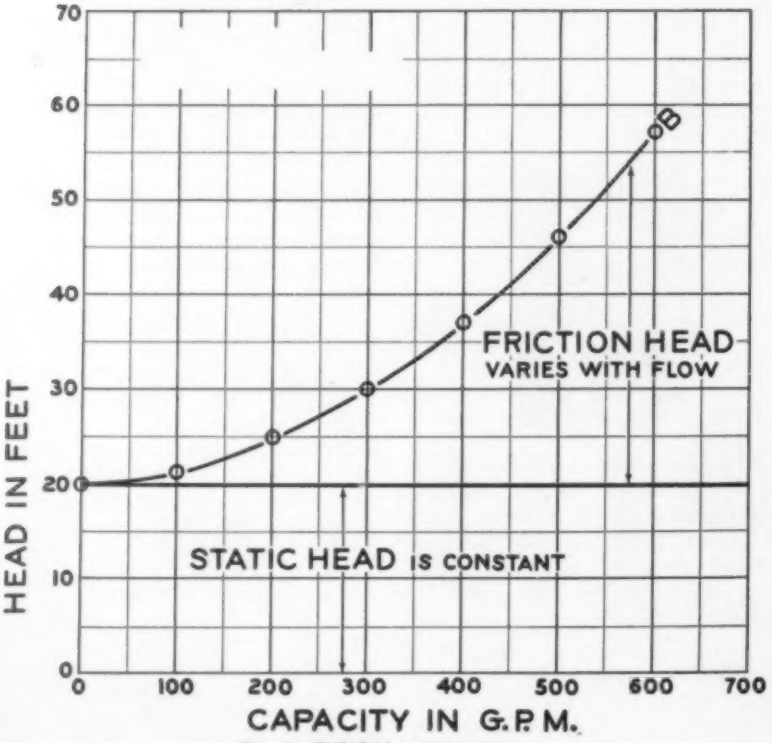


Fig. 2—TYPICAL system curve

THE work any centrifugal pump is capable of doing is best illustrated by drawing a curve. This curve is plotted by connecting a series of test points (Fig. 1). In selecting a pump for a specific job, one is chosen whose curve runs through the operating characteristics (for example, A in this case) required for the particular application.

It is up to the user, then, to determine definitely the specific set of conditions to be faced to be sure he gets a pump that will do the required job.

The demands that any installation places on the pump can also best be illustrated by a curve. As an example, the series of points representing how head requirements vary with changes in flow through a given piping network have been plotted (Fig. 2).

The head is usually a combined factor including some difference in elevation plus friction as the water or other liquid goes from where it enters the system to the point of departure. Usually the elevation difference, called static head, will be a constant. In this instance it is assumed to be 20 feet. In this curve of the system requirements, as flow increases so does friction. Let us also assume a 4-inch pipeline of 200-foot equivalent length, including fittings.

From an installation design viewpoint, such a curve is usually drawn or visualized to determine the rating to be specified. If Figures 1 and 2 are combined, we get Figure 3. If the system under consideration behaves according to curve B, the pump will do the appointed job. If the estimate is incorrect and the actual system has curves such as C or D, the pump will then operate at the corresponding point of intersection of the true system curve with the pump curve from Figure 1.

Varying conditions, such as differences in the source of water level at different times of the year, will similarly affect performance. The pump curve does not change, but the system

"Each pump has at least one eye,* many have two, and some more than that; but they can't even read their own nameplates."

curve can, thus altering performance accordingly.

From the foregoing it should be evident that accuracy is essential in specifying ratings. Only then can a pump be expected to perform at its best for a given requirement. Centrifugal pumps are really very obedient servants. However, they will only do what is asked of them, their nameplate data notwithstanding. Specifications including overly generous factors of safety here and there "to be sure to get a pump big enough" may even result in obtaining one incapable of doing the job at all. Don't let that happen to you . . . . and if it does, don't blame the pump.

*The inlet to a centrifugal pump impeller is called an "eye". Therefore a single-suction pump has one eye, a double-suction pump has two, and multi-stage has several.

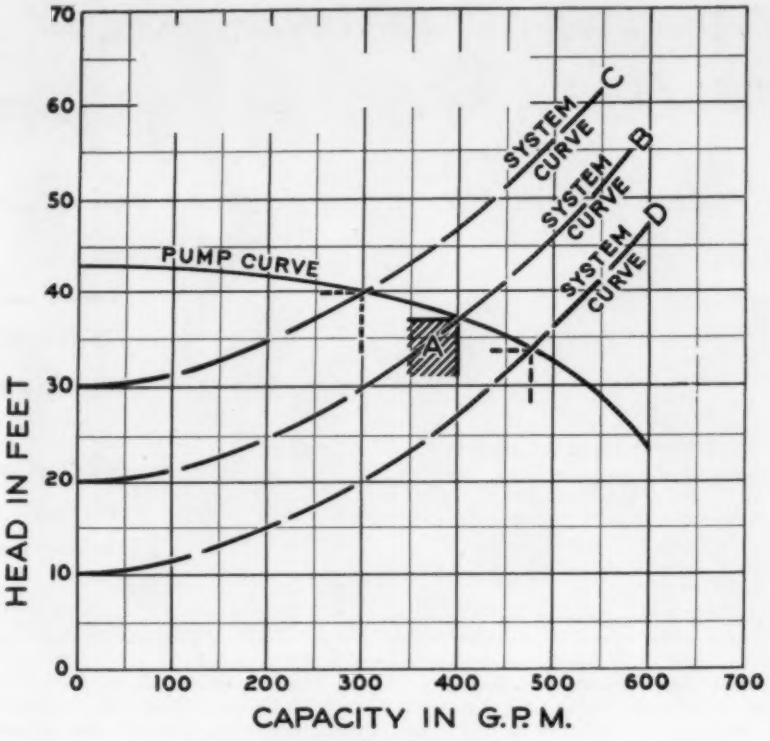


Fig. 3—COMBINED system-pump curves

Univ. of Cincinnati Plans New Course in Sanitary Engineering

A new graduate program in sanitary engineering will be offered starting in June and September 1957 by the department of civil engineering of the University of Cincinnati Graduate School of Arts and Sciences.

With Cincinnati rapidly becoming a world center for sanitary engineering research, a unique opportunity for graduate study in this field is being offered. Joining with the civil engineering department, Institute of Industrial Health, and Kettering Laboratory, all of the university, are the local Robert A. Taft Sanitary Engineering Center (national research laboratory of the United States Public Health Service), and the local Ohio River Valley Water Sanitation Commission.

Graduate students in the course will have the opportunity of working with these and other co-operating agencies. These include the university's Tanners Council Research Laboratory and the City of Cincinnati's division of sewage treatment. Engineers and scientists from all these organizations will assist the university's civil engineering department in formulating and staffing courses.

Open to full-time or part-time students in both the day and evening units of the university, the program leads to a master of science degree in sanitary engineering. A bachelor's degree in engineering or science is prerequisite. In general, full-time students will be able to complete the requirements for a master's degree in a 12-month period. Further information can be obtained from the department of civil engineering, University of Cincinnati, Cincinnati 21, Ohio.

"Bernie" Swab Joins O'Brien & Gere Engineers

Bernal H. (Bernie) Swab, P. E., has joined the consulting engineering firm of O'Brien and Gere in Syracuse, N.Y. Before coming to Syracuse, Mr. Swab was engaged in New Orleans where he acted as Consulting Engineer to Gulf Securities of Louisiana, Inc., and International Associated Engineers, Inc., on utility studies, reports and designs for projects in Tennessee, Louisianna and Florida.

He is a graduate of Purdue University, a member of the American Society of Civil Engineers, American Water Works Association and Federation of Sewage and Industrial Wastes Association."

Virginia's "Mr. Water and Sewage Works"

An unusual distinction came to "Phil" Kavanagh recently when he was elected president of the Virginia Industrial Wastes & Sewage Works Association, meeting in historic Williamsburgh, Va.

The unusual distinction is the fact that "Phil" Kavanagh, thereby, became Virginia's "Mr. Water and Sewage Works" because of the fact that he is also, and has been for several years, Secretary and Treasurer of the Virginia Section of the Am. Water Works Association.

J. Philip Kavanagh, a native Tennesseean from around Knoxville way, is a capable and popular adopted son of Virginia. He is District Manager for Wallace & Tiernan, Inc., with headquarters in Roanoke, Va.

Expanding and Improving

Water Distribution Systems

A technique for the determination of pipe net work conditions and needs

by **DONALD E. STEARNS**

Mr. Stearns is a consulting engineer in Cazenovia, N. Y. This article, perpared at our request, explains procedures for studying ailing and inadequate distribution systems.

WATER USAGE is showing a rapid increase year after year, although an inventory by the Business and Defense Services Administration shows that forty-two per cent of the public water supplies are inadequate in one way or another. It is apparent, therefore, that there is much work ahead in meeting expanded and rapidly increasing domestic, commercial and industrial requirements in both urban and suburban areas.

There are many times when it is not possible to meet local water needs because of an inadequate water distribution pipe network even though water resources are adequate. Many pipe networks are now having artery trouble. This may be due to tuberculation that has reduced main capacity; to undersized pipes in the initial system; to over extension of pipe mains; or to ineffective distribution systems either lacking in design or poorly designed.

Planning an economical pipe main strengthening program is a difficult task and calls for a careful appraisal of many factors and not simply adding another main to the system. Factors to be considered are: present condition of the pipe mains including valves and fittings; present and predicted future needs to be served; supply mains, pumping facilities and storage facilities now in service; and, of extreme importance, financial considerations.

It is the purpose of this article to outline an approach to the problem of distribution systems strengthening that the author has used and developed over the past 20 years and has applied to some 50 water systems both large and small. The chief objection to precise methods of studying distribution systems has been the desire to find a simple direct approach that could be readily applied. At best, it may be said, no method has been devised that permits a true hydraulic analysis of a pipe network without considerable expenditure of effort. The use of nomographs, the reducing of the elements of the system into convenient working forms, field testing of the elements of a water system, as well as the considered judgment of the person making the analysis all play an important part in the task.

Fig. 1—PORTABLE Bristol pressure recorder
Used to plot continuous record of pressures at selected points on the system

Field Data Required

Before any analysis can be made it is necessary to acquire considerable field data and to carry out certain basic field tests that furnish the necessary basic data for a hydraulic study. We accomplish this by first studying general maps of the distribution system, locating the main feeders, determining points in the system where pressure observations can best be made and points where drafts on the system may be required.

In our studies portable Bristol pressure recorders are used to plot a continuous record of pressures at these various selected pressure stations. See Fig. 1. These recorders have 2 speedclock driving mechanisms so that either a 24 hour pressure chart may be obtained or an accelerated recording made, the latter

lending itself more readily to interpretation.

While the pressure recorders are in service, drafts are placed on the pipe network at various locations so that measured flows may be taken and the variation in resulting pressures noted at the locations of the portable recording gages. Instead of the conventional Pitot Tube we have developed flow orifice nozzles that have been calibrated and are capable of a wide range of flow measurements. A single nozzle will record accurately flows from 25 to 600 gallons per minute. Four sizes of stainless steel orifice plates are used on the nozzles to accommodate this wide range of flows. For heavy drafts, two nozzles may be used on a single hydrant and also more than one hydrant can be flowed simultaneously. Figure 2 shows a nozzle in use.

Our experience has led us to test pipe networks in their entirety rather than individual pipe lines. We believe that the action of a pipe network with various pipes acting together gives much more significant and accurate results than single pipes. We feel that testing a pipe network in its entirety reflects the action of valves, fittings, appurtenances and other restrictions that may have a marked effect on the flow pattern. We have even found, as a result of this method of testing, the existence of mains not shown on existing maps and also pipe sizes that differed from the map size.

Altimeter Survey

After the actual flow tests and pressure recordings have been made, we then make an altimeter survey of the pipe network to determine elevations of points where pressures were recorded, hydrants where flows were made and points where residual line pressures were taken as a part of the field testing program. We use a matched pair of Wallace and Tiernan altimeters for this purpose; these are capable of indicating changes in elevation of about 2 feet. By carefully following the variation in temperature and atmospheric conditions even more precise results may be obtained. We find that the 2 foot accuracy is sufficient for the studies to be made and consistent with the other basic data that enter the study.

Our general procedure on an altimeter survey is to locate one altimeter at a Geodetic Bench Mark in the geographical area of the survey, and then to carry the other altimeter by car to the various points where elevations are desired. One observer reads the altimeter at the Bench Mark at frequent intervals and records both the time of observation and reading, while the other observer takes readings at various points on the pipe network. This makes it possible to record changes in atmospheric conditions while the survey is being made and to make corrections therefor. Often an entire community may be covered in a half day by two men while such a survey might require several days with a field party by other conventional methods. Elevations of storage facilities, pumping facilities, gravity supplies, etc. are readily obtained by this method as a part of the survey.

Fig. 2—NOZZLE for determining flow rate

Determining The "C" Value

With basic information on pressures, flows and elevations it is now possible to make office studies to determine the hydraulic behavior of the system being studied. Such studies reflect the present day condition of the pipes that make up the network. Computing the so called "C" value of the pipe network is the most common index of present condition. Although a "C" value of 120 is common for new pipe installations we find that a "C" value as low as 60 is common to many distribution systems that were installed between 1880 and 1900. Most of our present distribution systems in Central New York State were constructed the latter part of the 19th century.

To determine the "C" value of the pipe network, we first assume that all pipes in the system have a "C" of 100. We then reduce all pipes in the network to an equivalent length of 8 in. pipe or 12 in. pipe to facilitate further studies and to reduce the amount of computation necessary. It is now possible to determine the head loss across the pipe network for the above assumed pipe condition by means of nomographs designed for the purpose. Figures 3 & 4 are the nomographs used. These nomographs are based on the Hardy Cross method of flow analysis. A random flow is assumed to be taken off at a given point and the distribution of the feed in the various mains in the system is assumed. In other words if 1000 gallons per minute is being taken from the system at some point, a flow or feed of 1000 gallons per minute is distributed into the system over and above system leakage and other water usage beyond that being taken off at the point of draft. An analysis is then made and the heads balanced for any path of flow thru the pipe network until the head loss by any path thru the system is an equal or fixed quantity. This requires time and considerable judgment in order to keep the necessary office work to a minimum. It is true, however, that the answer obtained reflects a true hydraulic condition for the assumed flow.

Comparing the results for an assumed flow with the head loss obtained for an actual flow in the field offers a basis for determining the actual "C" value of the pipe network. There are many factors that may cloud the issue and complicate this

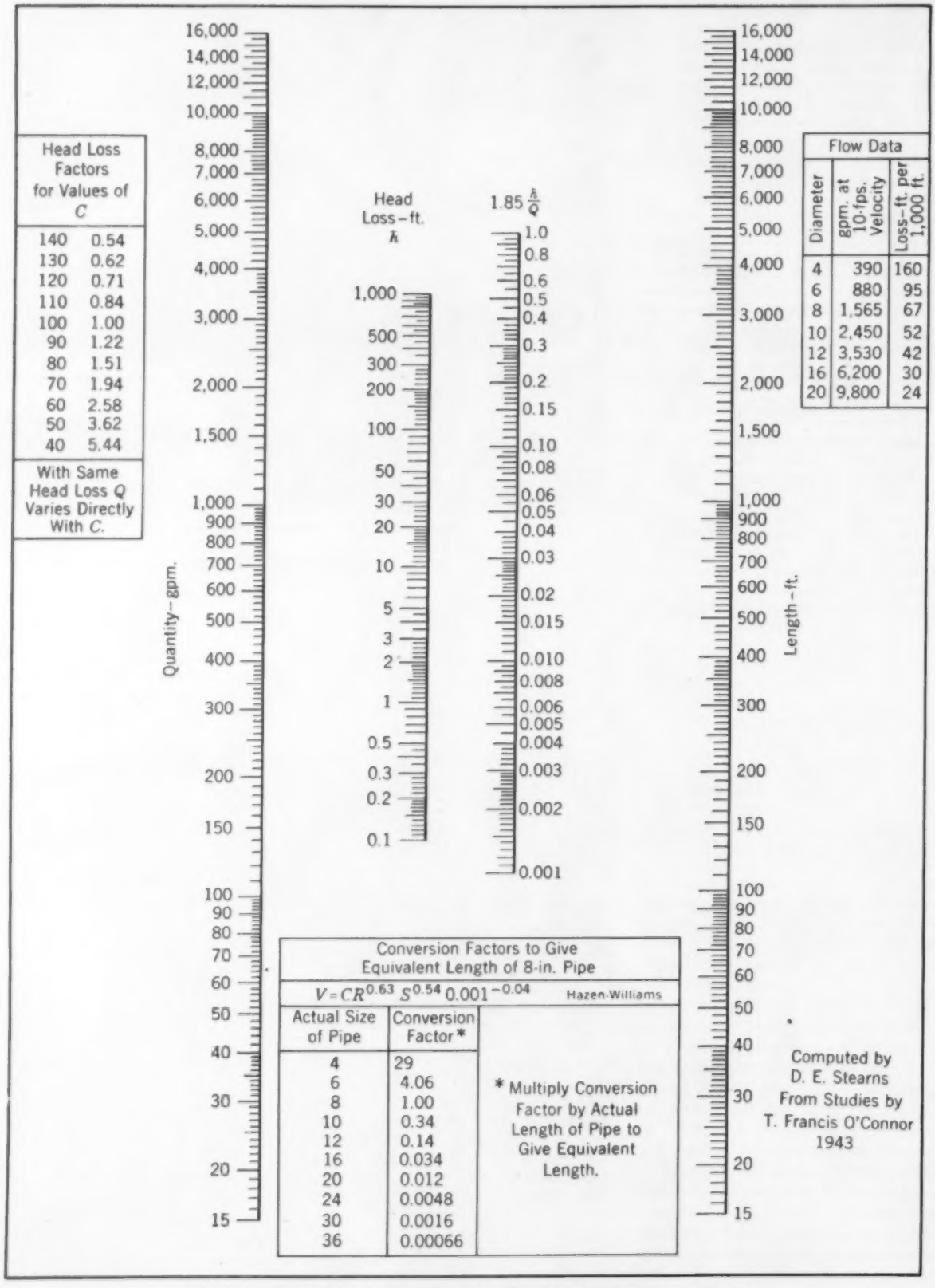


Fig. 3—NOMOGRAPH for flow analysis, based on Hardy Cross method
For pipe sizes 4 to 36-in.; head loss 0.1 to 1,000 ft.

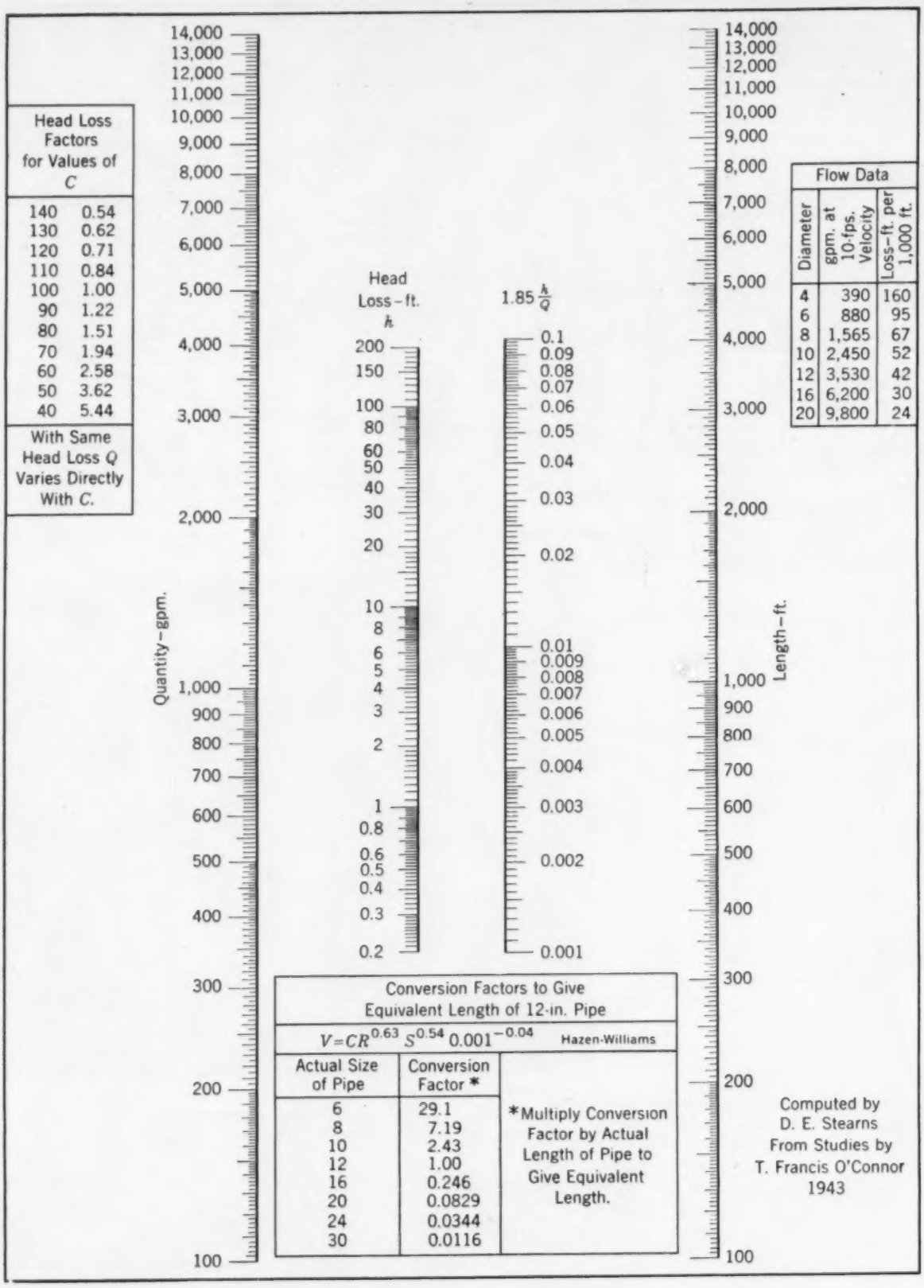


Fig. 4—Nomograph for flow analysis; based on Hardy Cross method
For pipe sizes 6 to 30-in.; head loss 0.2 to 200 ft.

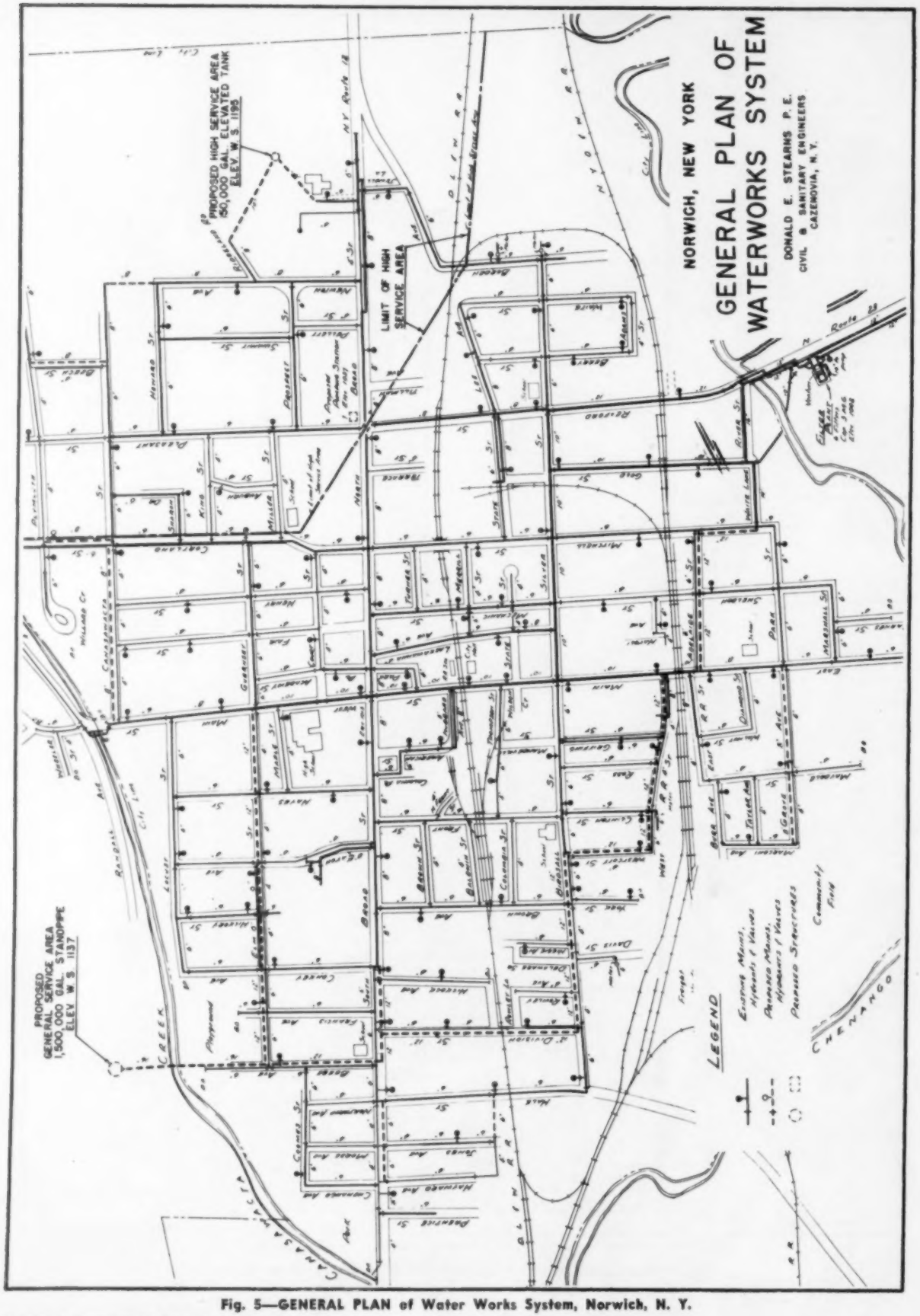

NORWICH, NEW YORK
GENERAL PLAN OF WATERWORKS SYSTEM
DONALD E. STEARNS P.E.
CIVIL • SANITARY ENGINEERS
CAZENOVIA, N.Y.
PROPOSED HIGH SERVICE AREA 150,000 GAL. ELEVATED TANK ELEV. W.S. 1195
LIMIT OF HIGH SERVICE AREA
PROPOSED GENERAL SERVICE AREA 1,500,000 GAL. STANDPIPE ELEV. W.S. 1137
LEGEND
CHENANGO

Fig. 5—GENERAL PLAN of Water Works System, Norwich, N. Y.

determination. Since the feed into the system may come from several sources which include a pumping station, gravity feed, combination of pumping and gravity and from one or more storage tanks or reservoirs it is necessary to account for all of these in the hydraulic study.

Determining Improvements Needed

Once the true condition of the pipe network is known it is possible to determine various improvements needed. These may be new pipe lines, additional storage or booster pumping. It is now important to keep a careful check on the cost of new facilities versus the improvement obtained so that the desired improvement to the pipe network may be made for the least expenditure.

Figure 5, "General Plan-Norwich, New York Waterworks System" indicates the new mains, pumping and storage facilities which we recommended after a comprehensive field and hydraulic investigation. Our studies showed the most economical solution to the problem to be a high service area and a general service area with separate storage facilities for each.

It is our opinion that when a desired improvement is under consideration, such as a pressure deficiency in a particular area, a careful study should be made to outline a broad improvement program that may reach beyond the immediate needs of the problem to be solved. Such a study permits future constructions at the proper time to achieve a complete system rehabilitation. It attempts to avoid the common "Hit or Miss" method of adding new mains to a distribution system with little regard for proper sizing or most effective location.

Too many times new mains are constructed where they do not accomplish the job for which they were constructed because there was no factual study made to show ahead of time what such construction could accomplish. In other words it was hoped that desired result would be accomplished but there was uncertainty until an actual test after construction showed the final answer.

The writer has seen several instances of this kind of loose planning and knows that it is a quite common and costly process. Technical advice for such improvements generally effects economies that are far reaching and significant. The engineer's job is to seek to determine the most economical solution that will solve the problem. Such a solution may result in an expenditure that may be only a fraction of what might be expended without such a study.

Subaqueous Portion of Raritan Valley Outfall Completed

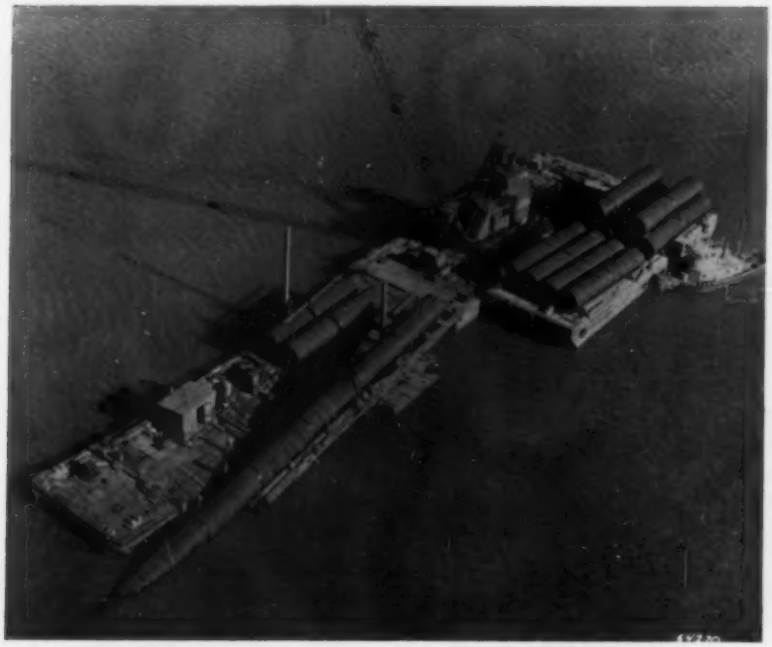


Photo courtesy of Armco Drainage & Metal Prod. Inc.

Aerial view of 84-inch sub-aqueous outfall being sunk into Raritan Bay off New Jersey coast.

The subaqueous placing of 6400 feet of 84-inch asbestos-bonded sewer pipe in Raritan Bay off the New Jersey coast was completed the middle of January utilizing economical method for assembly and placement of the pipe.

Twenty-foot sections were shop-matched, punched and field-bolted into 40-foot sections on shore near the underwater site. The sections were moved by barge to the working barge where they were bolted above water to the existing pipe.

The working barge was equipped with a sloping ramp with rollers on which the pipe could be assembled above the water and paid off into the water as additional 40-foot lengths were added. This resulted in above-water assembly of the entire length of line with only the occasional use of divers to check the final position of the pipe for alignment, grade and condition. The pipe was suspended from the barge in an arc of 200 to 300 feet long to where it touched the prepared foundation. After completion, the entire length was tested for watertightness. Minimum acceptable loss was 650 gallons of water per hour. Test results showed loss of 315 gallons per hour.

Foundation conditions were such that the natural muck material was removed to an elevation of at least 2 feet below the invert of the pipe and replaced with gravel. The pipe was covered with gravel dumped by barges to a depth of 5 feet. This cover was considered necessary to protect the structure against possible damage from dragging of ship anchors.

Kansas City, Mo. has adopted an ordinance requiring all new air-conditioning installations to be equipped with water-conserving equipment that does not use more than 6 gallons of water per hour per ton.

* * *

Strips of unglazed porcelain tiles when dipped in a mixture of 500 ml. of distilled water, 100 ml. of glacial acetic acid, 450 grams of C. P. lead acetate ($Pb\ C_2H_3O_23H_2O$) and 350 ml. of glycerine and allowed to dry, will serve as indicators of the amount of hydrogen sulphide there is in an atmosphere.

Color Coding in Your Plant*

A desirable practice in both water and sewage works.

by H. E. LORDLEY

Mr. Lordley is Assistant Director, Department of Public Utilities, City of Richmond, Va. **In this article he points out the major advantages of color coding the piping in the plant, and methods of accomplishing it.**

COLOR is an old word re-emphasized in today's world of color television, two-toned automobiles, and eye-soothing paints for the home and industrial plant. The superintendent of the smallest pumping station or the largest filtration plant can establish a color code for the identification of equipment and piping, both to facilitate repairs and to improve the general appearance of the plant.

Color combinations have been used since Biblical days for identification of armies by the color of their attire. As early as 1908, Bryan[1] presented a paper on the "Identification of Power House Piping Colors"; this was followed by various articles on the subject until 1920-21. In the early 1920's a number of associations published papers on methods of identification and the American Standards Association organized a committee on the subject in June 1922.

During World War II, industrial plant managers realized the importance of proper identification of piping systems when many inexperienced employees were hired, which resulted in unusual cross connections and costly shut-downs. The ASA Code was used in many of these plants, but the waterworks industry has been slow in adopting color coding. It is recommended that operators read the latest revision of the publication known as American Standards Association A13.1—1956, "Scheme for the Identification of Piping Systems,"

*At the request of the Editors, Mr. Lordley prepared this article as a modernized and updated version of an article which he wrote on this subject several years ago. Although this article was prepared with specific reference to a water plant, the basic ideas, concepts and information are just as applicable to sewage works where color coding is also highly desirable.

TABLE I

ASA System of Color Identification for Piping

Classification	Predominant Color	Legend Letter Color
F—Fire protection equipment	Red	White
D—Dangerous materials	Yellow (or orange)	Black
S—Safe materials	Green*	Black
P—Protective materials	Bright blue	White

*Or the achromatic colors white, black, gray or aluminum.

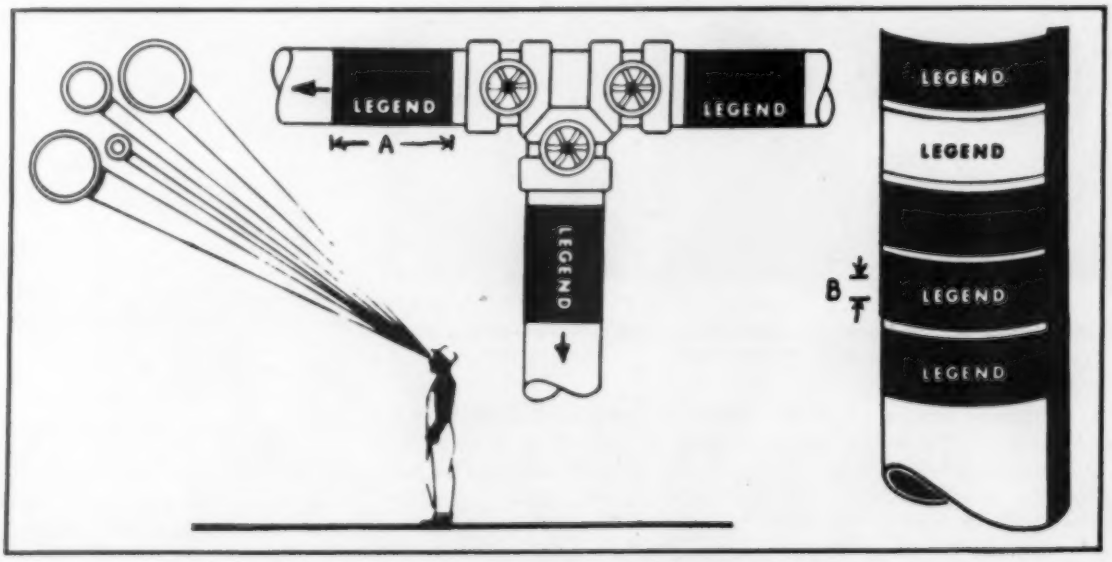


Fig. 1—LEGEND placement, width of color bands, and size of letters for various diameter pipes

From ASA "Scheme for the Identification of Piping Systems," by permission

TABLE 2

Classification Assignment of Materials

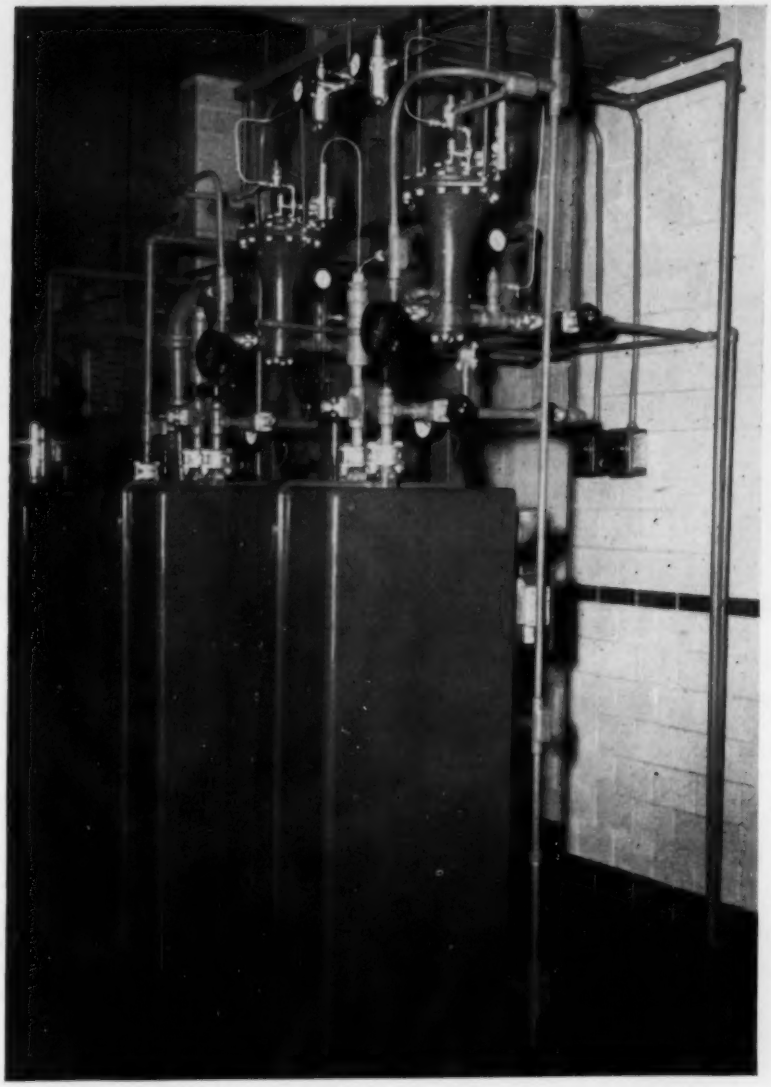
Material Piped	Classification
Alum solution	S
Carbon dioxide	D
Chlorine	D
Ammonia	D
Soda ash solution	S
Water	S
Steam	D
Water, fire protection	F

dated January 1956 and published by the American Society of Mechanical Engineers, 29 West 39th Street, New York, 18, N. Y.; price $1.00.

The first step in any system is to establish a definite color code according to the character of the various materials in the piping system. The ASA system is shown in Table 1. In this system all materials are listed and each assigned to one of the classes, as illustrated by Table 2.

Table 3 illustrates the system used in the Richmond, Va., plant identification of pipes common to water, plants. However, this system was established in 1940 and is not in conformity with the ASA recommendations previously listed.

The system has the advantage of a large number of colors and results in a variety of hues in an otherwise monotonus piping system. Many favorable comments on this color arrangement have been received from visitors particularly from classes of school children.



PIPING around chlorine evaporators in Richmond, Va., water plant
Illustration shows type of system requiring color coding for rapid identification of control valves as well as eye appeal for the many visitors

TABLE 3

Piping Identification Colors Used in the Richmond, Va., Water Plant

Piping	Color
Fire lines	Red
Sump pump lines	Red, white band
Raw water pumps	Red, white band
Drains on chemical machines	Red, white band
Waste water pump	Red, white band
Finished water	Dark green
Motors	Dark green
Electric conduit	Gray
Steam lines	Black, yellow band
Chemical lines	Orange
Chlorine	Yellow
Ammonia	Yellow
Sulfur dioxide	Yellow
Sewers	Light blue
Wash water pumps and lines	Light green
Air ducts	Aluminum
Hot water	Aluminum
Venturi meter lines and stacks	Brown

Methods of Application

The second step requires careful consideration and study in selecting the actual method of applying the colors selected. The entire length of pipe, plus the valves and fittings, may be painted the designated color. Or, the alternate method of painting color bands on piping having a uniform color may be used successfully. For example, it is often necessary to paint piping white or aluminum to improve illumination in pipe galleries, basements, or dark areas, in which case an identifying color band is painted adjacent to each valve, tee, or branch pipe.

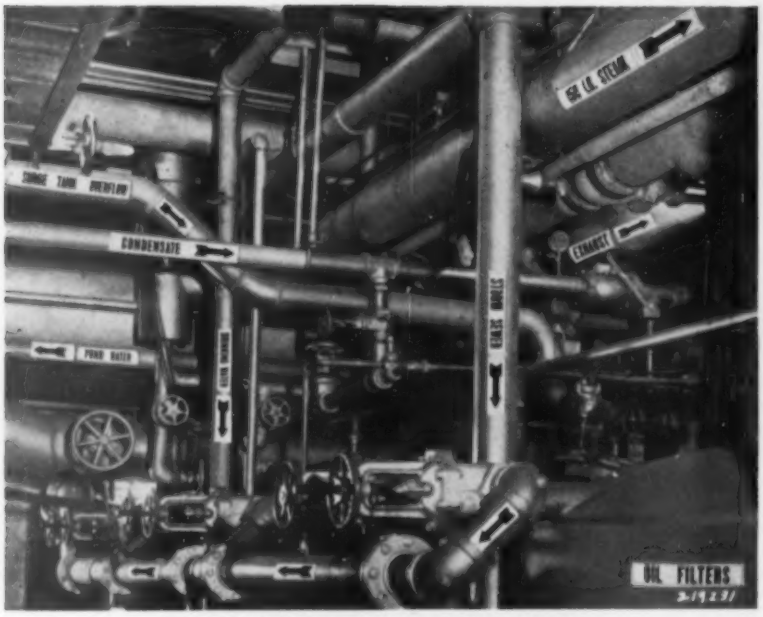
However, the author has found one disadvantage in painting entire lengths. It is a fact that painters become tired of using one color, which results in less footage per day than when switching to different colors. It is also interesting to note that in cases where one or more men are assigned the definite duty of painting,

TABLE 4

ASA Standards for Color Banding and Letter Sizing

Outside Dia. Pipe or Covering inches	Width of Color Band*, inches	Size of Legend Letters**, inches
3/4 to 1 1/4	8	1/2
1 1/2 to 2	8	3/4
2 1/2 to 6	12	1 1/4
8 to 10	24	2 1/2
Over 10	32	3 1/2

*Dimension A in Fig. 1.
**Dimension B in Fig. 1.



IDENTIFICATION of piping and flow direction
Easily accomplished with "stick-on" markers.

their personal interest and pride in the work increases in keeping each line painted the proper color. New employees assigned to painting learn the piping system quickly and can be transferred later to the mechanical maintenance division or the operating division with a thorough knowledge of the plant.

If a color band system is selected, this can be used in conjunction with stenciled words, letters and figures or more stripes of color at the edges of the band to indicate the exact identification of the system. Decals or plastic bands may be applied and are manufactured by a number of companies. W. H. Brady Co., 16 E. Spring St., Chippewa Falls, Wis., can furnish pipe markers for all materials and liquids normally found in a water plant. For example, labels can be ordered to identify raw water, treated water, waste water, hot water, cold water, well water, etc. An accompanying illustration shows how these "stick-on" labels can be used effectively.

Figure 1 shows the ASA system[2] for placement of legends on pipes. Table 4 gives width of color bands, and size of letters for various diameter pipes.

Color and Paint Selection

In selecting colors it always should be remembered that the reflective value of paints varies with the shade. Gray, which from a physiological or visual standpoint is situated about halfway between white and black, reflects approximately 25 percent of the incident standard white light, and is near the permissible limit of reflective value for poor illumination. In pipe galleries, aluminum or white paints give maximum illumination and increase the efficiency of maintenance operations.

The type and quality of paint used in a plant is often dependent on the judgment of the superintendent. Usually, he is required by the purchasing department to submit specifications on every item. Several government publications[3,4] are available to aid in the difficult job of selecting paint.

Labor turnover is increasing in water and sewage plants, making color coding essential for the safety of the employees. Civil Defense training also must be considered, and the possibility of outside assistance from other plants in the vicinity, in which case the identification of piping systems and equipment would aid in operating the plant.

References

1. Bryan, William H., "Identification of Power House Piping by Colors," ASME Proceedings, *30*: 773 (1908)
2. "American Standard Scheme for Identification of Piping Systems"—ASA A13.1-1956.
3. "Paint Manual." Report BMS, Catalog No. C 13.29: 105, available from Superintendent of Documents, Washington 25, D.C.; price $1.50 (Oct. 11, 1945).
4. "Index of Federal Specifications." Available from Superintendent of Documents, Washington 25, D.C.; price $1.75.

Manhattan College Holds Sanitary Engineering Conference

A Sanitary Engineering Conference on "Solids Handling and Anerobic Digestion" was held at Manhattan College, New York City, on April 24, 25, and 26th, 1957. Leaders in the field presented 30 papers reviewing latest advances in Sedimentation and Flotation of Solids; Chemical Conditioning and Vacuum filtration of Sludges; Anaerobic Digestion of Domestic and Industrial Wastes and Sludges. A report on the Conference will appear in our next issue.

This is the second conference on waste treatment processes sponsored by Manhattan College. Proceedings of the first conference (1955) "Biological Treatment of Sewage and Industrial Wastes," are available from Reinhold Publishing Corporation, New York City.

For additional information contact: W. W. Eckenfelder, Jr., Civil Engineering Department Manhattan College New York 71, New York.

Swedish Engineers To Tour U.S. Water and Sewage Plants

E. R. Rotchford, Manager of Journeys International, 2 West 46th Street, New York 36, N. Y. has been asked by a prominent travel association in Stockholm to prepare a 13 day U. S. A. tour for a group of 60 Municipal sanitary engineers.

The primary purpose of the visit is to study water purification and water supplies as well as the study of sewage, sludge and waste disposal and, of secondary importance is sightseeing in principal cities on the Eastern Seaboard, as well as mid-western cities such as Chicago, Detroit, as well as Washington, D. C.

The group will go direct from Stockholm to Boston where they will attend the FSIWA Convention from Oct. 7 to 10.

Following the convention they will follow an itinerary visiting cities which will give the group the most so far as their particular field of engineering is concerned and at the same time a little diversion by way of a scenic tour.

Anyone interested in having these men visit your plant or have any other suggestions toward making their trip worthwhile, should communicate directly with Mr. Rotchford.

EXPERIMENTAL BASINS for reclaiming domestic sewage by surface spreading at Lodi, Calif.

The Why and How of
Sewage Effluent Reclamation

by P. H. McGAUHEY

Mr. McGauhey is Assistant Director of the Sanitary Engineering Research Laboratory of the University of California at Berkeley, Calif. In this article he discusses the vital topic of sewage reclamation as a water source.

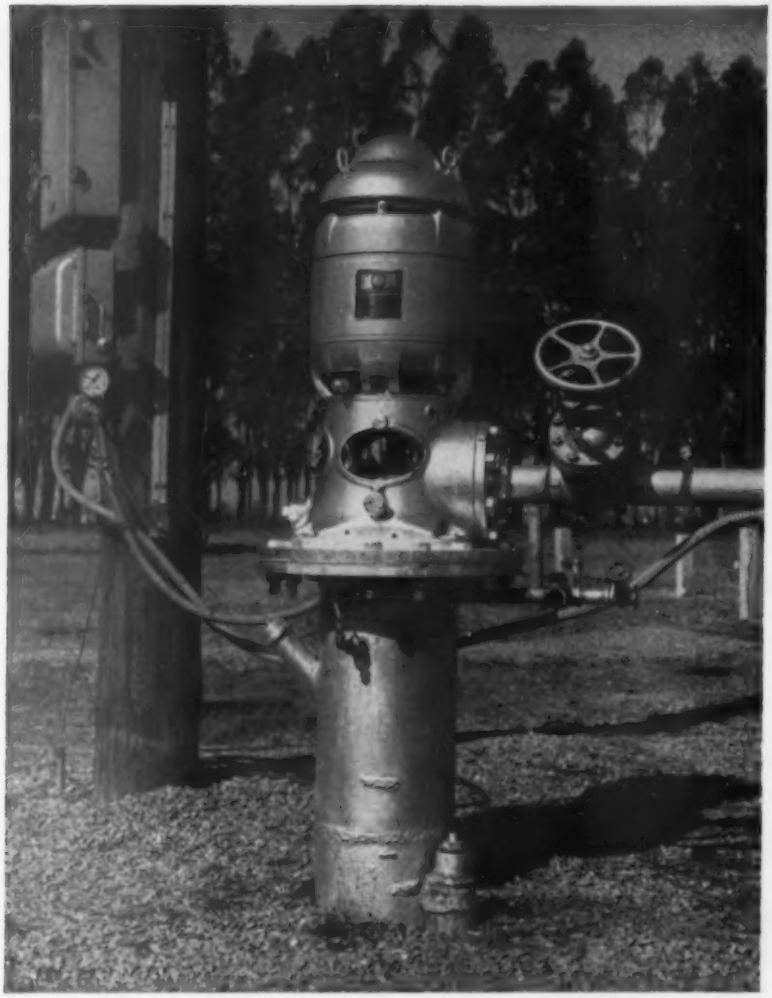
DURING the past few years there has been an increasing awareness in California that the traditional "once-only" usage of water is a luxury the state can ill afford. Funds have therefore been made available for research on the public health and engineering problems involved in salvaging water, and at least one major conference has been called to discuss the administrative, legal, and economic aspects of waste water reclamation. The State's water problems, however, are of such magnitude, and the proposals for their solution so challenging, that scale size alone has often tended to obscure the importance of waste water reclamation. Nevertheless, a healthy interest in the possibility of reclaiming sewage effluents has been manifest throughout the past five years.

Ed. Note: This paper was presented before the Public Works Officers Department at the Annual League Conference in Los Angeles, Calif., and released for publication here.

What Is Sewage Reclamation?

In a broad sense "sewage reclamation" might be defined as the purposeful upgrading of the quality of sewage with the intent of making it re-usable by agriculture, industry, or the public. Such a definition has by no means been standardized, and the term "reclamation" is sometimes applied to the actual utilization of sewage effluent which for some other reason has undergone suitable treatment. In any event the term does not apply to incidental reclamation achieved by dilution of sewage discharged into watercourses for the purpose of disposal, even though water from the stream may be suitable quality for beneficial use. Nor does it apply to the treatment of sewage for the mere purpose of disposal.

Historically, advancing sanitary



RECHARGE WELL for reclaiming sewage treatment plant effluent by direct injection into underground water bearing stratum at Richmond, Calif.

standards of growing population has made it necessary to consider public health, aesthetics, and the rights of other water users in the matter of sewage treatment. Such considerations determine the degree of treatment to be imposed in any situation, but the purpose of treatment has always been to achieve whatever minimum modification of sewage is required before it may legally be thrown away. Fortunately, the upgrading of sewage in order to meet the requirements of disposal lessens, and sometimes accomplishes, the task of reclamation. In other cases, however, it commits a community to a program inimical to sewage reclamation in the immediate future.

Need For Re-Use of Water

The quantity and distribution of available water with respect to the population concentrations in California is the principal reason why sewage effluents might well be reclaimed for local re-use. Although the studies which led to the California Water Plan show that there is enough water in the state for everyone if it is wisely conserved and developed in an intelligent manner, the fact remains that development of the Water Plan calls for time, while serious water shortages and ground water overdrafts are immediate in many areas of California. The details of this story of rapidly declining ground water, sea water intrusion, and water shortage have been told so often that they need not be repeated here. They do, however, underscore the need for multiple usage of the water which is presently available.

There are reasons in logic also why sewage effluents should be reclaimed and re-used. If sewage were discharged without any treatment whatsoever, we should be sending a 2000-ton train of water, on which we lately spent a great deal of money in purifying, to transport a single ton of organic solids. Worse yet, in the more common case of well treated sewage, one good burro could carry all that is required of this half million gallons of water. Furthermore, we throw away the train at the end of a single trip. It is in line with our heritage of waste, but it is without parallel in the history of transportation.

Sewage as a Source of Water

If we are seriously to consider sewage as a source of reclaimable water it is important to know how

TABLE I

Comparison of Estimated Cost of Reclaimed Sewage and Cost of Alternate Water Supply in the Southwest

Location	Cost of Water	Cost of Reclaimed Sewage	Use
Golden Gate Park San Francisco, Calif.	$66/acre ft	$21/acre ft	Lawn & Shrub irrigation ornamental lake
Grand Canyon, Ariz.	$550/acre ft	$120/acre ft	Lawn irrigation
Los Alamos, New Mexico	$92/acre ft	$24/acre ft	Power plant cooling water
Carlsbad, New Mexico	—	$25/acre ft	Irrigation of Golf Course
Santa Fe, New Mexico	$75/acre ft	$49/acre ft *	Irrigation of Golf Course
Las Vegas, Nevada	$30/acre ft	$27/acre ft	Irrigation of Golf Course
Jal, New Mexico	—	$69/acre ft	Irrigation of Golf Course
Big Springs, Texas	$51-$105/acre ft	$15/acre ft **	Boiler feed water

* Includes cost of delivering 3½ miles.
** Includes only part of treatment cost.

much water is involved, and what is its availablity to potential users. When the total consumptive use of water is considered, it is easy to depreciate the importance of that portion finding its way into sewers from domestic and industrial users; and this has often been done. It has conservatively been estimated[1] that 6 million acres of new irrigated cropland will have to be brought into full production by 1975 if we are to maintain our present standards of nutrition. Presumably this acreage will lie in the 17 western states, and will require an average of not less than 3 acre-feet of water per acre per year —or 18 million acre feet annually. The 1950 census showed this area to have a population of about 34 million. Assuming that the present population is, say 40 million, and that 60 percent of these live in sewered communities, the total sewage flow would be but 3 million acre feet per year, or 1/6 the agricultural need for new water if the entire sewage flow could be reclaimed. When allowance is made for that portion of the population located in areas or surplus water, in mountains, and in other localities remote from irrigable land, it is probable that considerably less than 10 percent of the agricultural need for water in the west could be met by sewage reclamation. This is certainly the case in California where 90 percent of the water goes into irrigation of crops. Assuming the other 10 percent to be domestic supply, of which 70 percent reaches the sewers, reclamation of the entire sewage flow from California's urban centers would add but 8 percent to the water available for irrigation.

This line of reasoning simply means that the production of water for agricultural use can hardly be the principal goal of sewage reclamation. For other potential uses the story is more favorable. On the basis of California's 13 million people, and assuming that 80 percent of the population lives in cities, domestic sewage equals about 40 percent of our presently estimated 2 million acre-feet of annual overdraft on ground water basins for all uses. This is an important amount of water. Making allowance for sections of the state where reclamation of sewage for agriculture or for ground water-replenishment seems patently uneconomical, it appears that sewage reclamation might be feasible in an amount equal to say 20 percent of our present ground water overdraft.

Using something other than the vast needs of agriculture as the yardstick of water quantity it can again be shown that presently wasted sewage represents an appreciable volume of water. For example, approximately half a billion gallons of water are wasted to the ocean each day after a single usage by the inhabitants of California's two greatest concentrations of population. This might represent the combined yield of 350 12-inch wells each producing 1000 gpm continuously; it is enough water to produce 7800 tons of steel daily at the normal figure of 64,000 gallons

TABLE 2

Summary of Direct Re-Use of Sewage Plant Effluents in the Western States

Location	Nature of Principle Usage
ARIZONA	
Bagdad	Mining Industry - ore dressing
Hayden	" " " "
Inspiration	" " " "
Miami	Mining Industry - ore dressing; Park Irrigation
Morenci	" " " "
Tiger	" " " "
Grand Canyon	Power Plant-Cooling Water; Lawn Irrigation
CALIFORNIA	
Bakersfield	Irrigation - animal feed crops & Cotton
Delano	" " " " "
Fresno	" " " " "
Hanford	Irrigation - animal feed crops & sorgum
Mt. Vernon (San. Distr.)	Irrigation - animal feed crops & cotton
Ontario	Irrigation - animal feed crops & grain
Pomona	Irrigation - animal feed crops & citrus
San Bernardino	Irrigation - animal feed crops & orchards, berries
Tulare	Irrigation - animal feed crops & cotton
Taft	Irrigation - cotton, maize seed
Wasco	Irrigation - cotton, maize seed & cotton
Barstow (USMC Depot)	Irrigation - golf course
El Cajon	Irrigation - golf course
El Toro (Marine Base)	" " "
Camp Pendleton (Marine Base)	Irrigation - golf course
San Francisco (Gold. Gate Park)	Irrigation - park and lawn, lake
Twenty-nine Palms (Marine Base)	Irrigation - recreational fields
Escondido	Quarrying Industry - Sand & Gravel Washing
Fontana	Steel Industry - process & cooling water
San Bernardino	Power Plant - cooling water
NEW MEXICO	
Hurley	Mining Industry - process water makeup
Carlsbad	Irrigation - golf course
Jal	Irrigation - golf course
Los Alamos	Irrigation - golf course & recreation fields
Santa Fe	Irrigation - golf course
Los Alamos	Power Plant - cooling water
TEXAS	
Amarillo	Oil Refining Industry - cooling water
Big Springs	Oil Refining Industry - cooling water & boiler feed water
Dallas	Power Industry - boiler feed water
Abilene	Irrigation - animal feed crops
Kingsville	Irrigation - animal feed crops & cotton
Lubbock	Irrigation - grains, cotton
San Antonio	Irrigation - animal feed crops
San Antonio	Lake for wildfowl
NEVADA	
Las Vegas	Irrigation - golf course, lawns
UTAH	
Provo	Steel Industry - process water

RECLAMATION of water from sewage by algae at Concord, Calif.

per ton; or to meet the waterneeds in refining of 615,000 barrels of petroleum per day even if cooling water was used but once; it represents 0.85 percent of the total industrial use of water in the entire United States; and, yes, it would irrigate 100,000 acres of land even if nearly half of it were lost to evaporation during storage.

From the foregoing rough comparisons we may understand that in speaking of sewage reclamation we are indeed speaking of an important amount of water, even though much greater amounts may be needed by agriculture.

Who Shall Make Use of Reclaimed Sewage Effluent?

The fact that sewage plant effluents occur in population centers suggests at once that the activities of these centers are the logical ones in which reclaimed effluents might be re-used. Specifically, this means in industry, in local irrigation, and in domestic supply. The first two of these are the most promising because they can use reclaimed water directly after much less treatment than would be necessary for a domestic water supply. In fact aesthetic considerations as well as cost of refinement of water quality preclude the direct re-use of sewage effluent in the home. It may, however, be used by the public to recharge ground waters, and thus later become a part of the water supply, or to irrigate parks and golf courses, or, as in the case of San Francisco, to maintain recreational ponds as well. In large cities some use may be made of reclaimed sewage in peripheral agriculture or in the maintenance of pasture land for dairy cattle not currently producing milk, or for beef animals, but industry seems the logical user. In the vicinity of smaller cities, however, grain crops, orchards, and pasture land may be the principal outlet for reclaimed sewage effluent.

Why Have We Been Slow to Re-Use Waste Waters?

A number of factors enter into our past and our present failure to reclaim sewage effluents for beneficial use. Valid technical, engineering, economic, and legal problems as well as psychological considerations have only recently been defined and partially solved. In fact, our national psychology of wastage of all second-hand things has done much to delay vigorous attention to the practical problems. Coupled with this has been a curious discontinuity in our concept of water usage, which causes many engineers and public officials to think of the collection, transportation, treatment, and distribution of water supply as one complete package; while the re-collection, transportation, and re-treatment of that same water is an unrelated job of scavanging.

In 1930, Goudey[2] demonstrated that a highly treated sewage could be safely applied to the ground water by surface spreading, and in 1949, Arnold, Hedger, and Rawn[3] found ground water recharge with treated sewage to be both technically and economically feasible. A general lack of interest in sewage reclamation, however, delayed further scientific investigation and thus limited the possible methods of reclamation essentially to irrigation of crops not meant for human consumption in a raw state. Inasmuch as such croplands are generally inaccessible to large sewage treatment plants, reclamation by this method is of limited feasibility. Until quite recently it was believed that direct recharge of ground waters was impractical because of clogging due to suspended matter in sewage effluents; and it was feared that pathogenic bacteria might travel long distances with moving ground water.

Direct re-use of sewage plant effluents by industry was likewise given little serious consideration. Industry's traditional pride in i s concern for economics only could not be refuted by advocates of sewage reclamation in the absence of experience. In adidtion, effluent available at a central treatment plant is expensive to transport back upstream to the site of potential users. The city itself looks with dismay on the prospects of laying another conduit in a paved street already underlain with various utilities. And it is a considerable nuisance to keep two water systems separated within a plant.

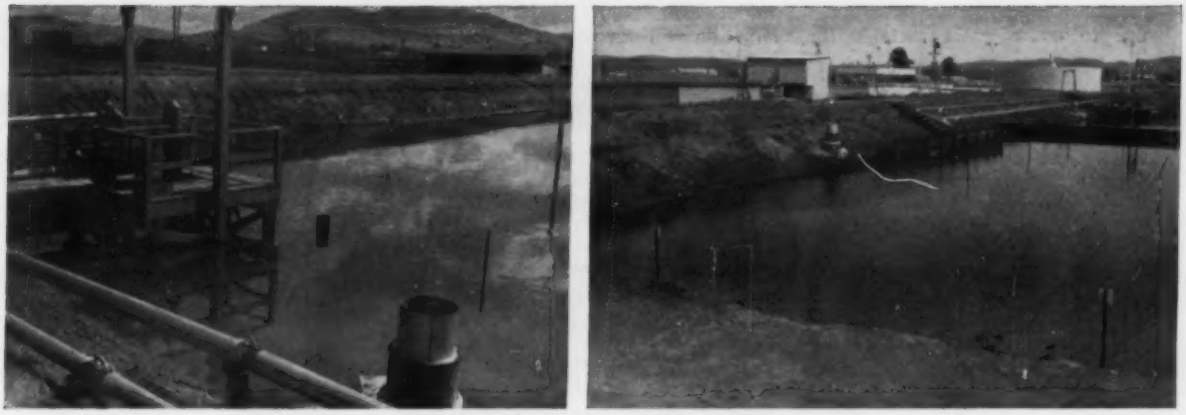
Ventures into sewage reclamation are further inhibited by the fact that the economics of waste water utilization are not known. In any event, why pay the cost of sewage reclamation when it is cheaper and permissible to mine out existing ground waters, regardless of the long term consequences to water resources. The whole concept of water rights is a deterring factor to sewage reclamation. Who, for instance, owns water recharged underground at public expense? And what restriction may be placed upon its withdrawal from an already overpumped ground water basin?

A unique situation has contributed to the lack of progress in sewage reclamation in Southern California, where the largest volume of plant effluent is available. In its simplest terms it evolves around two questions: why use Colorado River water as long as the ground water lasts at $5 per acre foot? and why go to the expense of reclaiming sewage as long as we are paying for Colorado River water which we are not presently using? In such a situation, there is little choice but to wait until a more appropriate time. In the meantime the pressing problems of sewage disposal will probably cause expenditures to which it may be economically unfeasible at a later date to add other expenditures for reclamation. This is another reason why we have been slow to reclaim sewage.

In general, it might be said that we have been slow to re-use waste water because we have just not been sufficiently interested in doing so, or in solving the problems necessary to make it possible, as long as we can get along without it.

What Is Known About Sewage Reclamation?

As previously noted it was demonstrated in Los Angles in 1930 that



TWO VIEWS of Concordia, Calif., sewage reclamation ponds employing algae.

highly treated sewage effluents can be safely used for ground water replenishment; and again in 1949 engineers in this same area found ground water recharge by spreading to be economically and technically feasible. Their recommendation that the method be used to reclaim 125 million gallons of sewage per day on eight spreading basins in the Los Angeles area was not followed, but the experimental spreading grounds at Azusa from which they[3] drew their conclusions have continued to perform satisfactorily, and represent today the principal example of sewage reclamation by spreading.

Within the past five years experiments in sewage spreading on soils much finer than the Azusa gravels have been conducted on a field scale at Lodi, and on a smaller scale at Richmond, Calif., by researchers of the University of California. These studies have been sponsored by the California State Water Pollution Control Board, the State Department of Public Health, the U. S. Public Health Service, and the University itself. Among the many findings was the fact that sewage can be applied to the five types of soil investigated at a rate of about one-half acre-foot per acre per day; and that intestinal bacteria are removed from the liquid within the first four feet of travel through the soil.

Since 1951 the California State Water Pollution Control Board has also financed a 3-year study of sewage reclamation by direct injection into ground water. From this study a practical method of recharge well operation was developed and the public health safety of such a reclamation procedure was demonstrated. Bacterial travel with moving ground water did not exceed 100 feet even though the settled sewage introduced carried very high concentrations of organisms. Other studies financed by the Board and still in progress have brought together existing evidence that grains, grass land, orchards, golf courses, etc. may be safely irrigated with seawge plant effluents. Other evidence shows that such effluents may be economically used by industry for cooling water and other plant needs.

From economic studies in progress at the University of California at Berkeley, it is concluded that when the cost of treating sewage to the degree demanded by public health and water pollution is charged to such considerations, reclaimed sewage plant effluents can in many cases be profitably used in irrigation in competition with water selling for $6 to $10 per acre-foot. Furthermore it can compete with the $6 to $24 per acre-foot paid by industry for much of its boiler feed water and cooling waters. In more arid areas it has already been shown that water reclaimed from sewage may be economical even if all treatment costs are charged against the value of the water. Table 1 presents comparative costs of new and reclaimed water at a few places in the southwest.

While the foregoing conclusions by no means summarize all that we know about sewage reclamation, they may serve here to point up the fact that sewage effluents may be reclaimed by ground water recharge, or by direct re-use on the land or by industry; and that such reclamation is technically and economically feasible as well as consistent with public health considerations. The things we do not know about sewage reclamation are mostly those which can be learned only from experience, and from a willingness to make the necessary political and legislative arrangements.

Present Status

Some positive developments in sewage reclamation and utilization have taken place in California and elsewhere in the southwest in recent years. Many of these have been undertaken without the benefit of scientific knowledge, and generally in localities where a water shortage is immediate or where the need is urgent to dispose of sewage effluents in the most economical fashion acceptable to health or pollution control authorities. In 1954, 74 communities and 32 public and private institutions in California were reported[4] to be using sewage effluents for irrigation of crops and pasture. At the same time, the use of effluents for some type of surface spreading or ponding was reported by 78 communities and 36 institutions in the state. Only a few of these were sizeable communities; in fact the total population contributing to the sewage used for irrigation was but 250,000. Most had no well engineered reclamation procedures, hence it is probable that in terms of what we are doing in planning sewage reclamation the figures are deceptive, including a great many places simply concerned to be rid of sewage plant effluents where no receiving water is available. In larger communities such as Fresno and Bakersfield, California, reclamation is deliberate rather than incidental, but in almost no case has a treatment plant been designed specifically for water reclamation. The single exception in California, as far as I know, is the plant in San Francisco's Golden Gate Park, which was designed specifically to produce an effluent suitable for a recreational pond and for irrigation of shrubs and grass.

In general, and this is true of all of the southwest as well as of California, sewage reclamation is what we do with existing treatment plant

effluents, rather than what we do to sewage to make water suitable for further beneficial use.

Direct re-use is perhaps the only method of sewage reclamation currently in practice. An extensive report[5] published by the California State Water Pollution Control Board in 1955 and summarized in Table 2 shows that industry makes use of sewage treatment plant effluents in 7 communities in Arizona; 4 in California; 2 in New Mexico; 4 in Texas; and 1 in Utah. Irrigation of crops, pastures, lawns, golf courses, etc. with sewage effluents was reported at 2 places in Arizona; 17 in California; 1 in Nevada; 4 in New Mexico; and 4 in Texas. San Antonio, like San Francisco, utilizes sewage effluent in a recreational lake. No instance of direct injection into water bearing strata is reported in the literature.

Although the practice of sewage reclamation at present is largely confined to small, and often rudimentary, undertakings several instances in the southwest represent well planned projects on a scale sufficiently great to demonstrate the engineering feasibility and practical economy of direct re-use of sewage effluents.

Prospects for the Future

Although extensive field and laboratory investigations have shown that the reclamation of water from sewage is feasible by known techniques, its widespread adoption is likely to depend upon a number of factors which are slowly becoming recognized. One of these is a revised concept of sewage and sewage reclamation; another is the idea that the sewage disposal and water reclamation aspects of sewage treatment are not necessarily synonymous.

In the matter of new concepts is the full realization that treating sewage to the degree required by regulatory agencies is in reality a procedure which restores some degree of quality to a water in which the city already has a large investment. This water must then be recognized as a resource which is valuable not only because it is capable of re-use, but also because it exists within the city and is immediately available. Furthermore, it must be recognized that the importance of this resource is not diminished by the fact that in volume it does not equal the needs of agriculture, or by the fact that elsewhere there exists unused water which may some day become available to the city.

From the standpoint of reclamation versus sewage disposal it seems probable that in the future sewage reclamation will develop as planned reclamation rather than as simple marketing of sewage plant effluent now being wasted to the ocean. Because of favorable economic factors and freedom from legal involvements this reclamation will undoubtedly develop more rapidly around direct re-use in industry and in irrigation, than around ground water replenishment. Reliance on sewage treatment to reclaim water, as at present, results in serious drawbacks. The effluent is concentrated at a point of poor availability to the user, especially the industrial user. In addition, there is a tendency to require the user to take effluent continuously. This restricts the crops which may be grown as well as the land use in agriculture, and involves impounding problems in industry. Both seriously depreciate the value of reclaimed effluent and may make the process uneconomical. Then too, there is always the danger of losing sight of the public health interest in sewage treatment and to become unprepared properly to cope with a situation in which some catastrophic event, such as a chemical spill, renders the sewage temporarily unreclaimable.

Successful sewage reclamation plants of the future may be expected to be divorced from the sewage treatment plants in the manner suggested on various occasions by A. M. Rawn, of the Los Angeles County Sanitation Districts. They will be unit plants of appropriate size placed along the sewer system at points strategically located with respect to industrial users. Some portion of the sewage will therefore always remain in the sewer and will require treatment prior to disposal.

While data on the economics of reclaiming water from sewage are fragmentary, it seems evident that economic considerations will not rule out sewage reclamation, although the vagaries of cost may be a delaying factor. As ground waters approach depletion, and as the cost of transportation of water from more distant sources is felt, there will be an upward revision of the value of water. The time required for completion of various segments of the California Water Plan may also increase the value of water by reason of local shortage. All of these factors may combine to enhance the value and importance of reclaimed sewage effluents.

The future of sewage reclamation might well be summarized by the concensus of representatives of federal, state, and local governments; industry; agriculture; and other interests who took part in a conference on waste water reclamation held in Berkeley in 1956. It was generally felt that there exists no undue legal obstacles to the reclamation and re-use of water from sewage; that reclamation is technically feasible; and that existing water and irrigation districts are so constituted that the development of administrative machinery is not a deterent to practical waste water reclamation. No one seemed to doubt that sewage reclamation will be a part of the orderly development of California's water resources.

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Hal Hunt Becomes Executive Editor of "Civil Engineering"

Lockwood Becomes Ass't to the Exec. Secy of ASCE.

Hal. W. Hunt, until recently on the editorial staff of "Engineering News Record", has been appointed Executive Editor of A.S.C.E.'s "Civil Engineering", as announced by Walter E. Jessup, Editor.

Mr. Hunt, a member of A.S.C.E., comes to "Civil Engineering" with long experience in engineering construction, representing both owners, and contractors, plus a background of eight years of editorial experience with "Engineering News Record". In addition, he has had an interest in and participated in a number of A.S.C.E. activities.

Mr. Hunt succeeds "Bob" Lockwood, Executive Editor of "C.E." until his recent promotion to become assistant to the Excutive Secretary of A.S.C.E. in charge of the work of the Department of Conditions of Practice.

Two Procedures For
Grit Chamber Design

by E. L. MacLEMAN

Mr. MacLeman is Assistant Professor of Civil Engineering at Yale University in New Haven, Conn. In this article he presents a subject of particular interest to engineers.

NUMEROUS devices have been designed in attempts to maintain a grit chamber velocity near the ideal of one foot per second. Since no control to date has been able to successfully maintain this horizontal velocity for all flows, regulatory agencies have established limits which generally fall within a range of 0.5 to 1.2 feet per second. Between these limits a grit chamber should perform its design function of removing inert, gritty material while passing the putrescible organic matter.

Two well known control devices are the Parshall Flume[1] and the Proportional Weir[2]. With proper design, they will control the velocity within the allowable range. This has resulted in widespread adoption of these two measuring devices.

It is the intent of this paper to present an outline of procedures for the design of grit chambers with each type of control.

Before proceeding further, it might be well to review generally accepted information pertaining to rectangular grit chambers. The detention period should range between 0.33 and 1.5 minutes, while the length should be from 30 to 90 feet. The latter may be computed from the following relation based on the ideal settling basin.

$$\frac{L}{H} = \frac{V}{v_o} \qquad (A)$$

Where:

- L = Length of settling chamber. (ft)
- H = depth of sewage. (ft)
- V = mean horizontal displacement velocity. (ft/sec)
- v_o = settling velocity (ft/sec) of particle for which 100% removal might be expected (also referred to as the overflow rate when written as

$$v_o = \frac{WH}{L}\frac{V}{W} = \frac{Q}{LW} \text{ (g/d/sq ft)}$$

- W = width of settling basin. (ft)
- Q = quantity of sewage. (g/d)

It has been suggested that the overflow should be within the limits of 17,000 to 50,000 gal/day/ft^2. Maximum overflow rates for approximately 100 per cent removal of various size particles has been presented by W. A. Kivell and N. B. Lund[3].

Experience indicates removal of particles 0.2 mm in diameter with a specific gravity of 2.65 will result in the elimination of material which gives the most trouble in sewage treatment plants. The settling velocity V_o most commonly used with this size particle is 0.075 ft per sec.

TABLE I[3,5]

Relation of Particle Size to overflow Rate

Diam. of Particles to be removed, mm.	Overflow Rate gal/day/sq ft.
0.79	73,000
0.36	51,000
0.28	38,000
0.17	25,000

The critical displacement velocity required to scour material for which removal is desired, may be determined by the following formula derived by Camp[4] from studies by Shields.

$$v_c = 1.3\sqrt{(s-1)\,d} \qquad (B)$$

where

- v_c = critical velocity (ft/sec)
- s = specific gravity
- d = diameter of particle to be removed (mm)

The volume of grit storage required will be principally determined by the cleaning interval. Continuous cleaning is generally provided only at the larger installations; although mechanical grit chambers are definitely desirable for plants handling flows of 3 mgd or more, especially if servicing combined systems.

Suggested Design Figures for Volume of Grit Storage:

Combined sewers	10-30 cu ft/mil gal
Separate sewers	2-10 cu ft/mil gal

Design of Grit Chambers with Sloping Sides

CONTROL: *Parshall Flume*

The velocity in a rectangular grit chamber, will theoretically be maintained between the suggested limits, by a rectangular control section when the maximum and minimum flows vary within a ratio of 13.7 to 1. This may be checked by the formulation for discharge through a rectangular control section.

$$Q = kBH^{3/2} \qquad (C)$$

where k = constant which approximates 3.5

B = width of the control section (ft)

However, if the cross section of the grit chamber is made parabolic, then the velocity will approximate 1 ft/sec. for all flows. Camp[4] has developed formulation for such a cross-section. (See Fig. 1).

$$x = \frac{3}{2}\frac{kB}{V}\sqrt{y} \qquad (D)$$

also for maximum depth, based on (C) and (D) when $W = 1.25\,H_{max.}$

$$H_{MAX} = 1.1\sqrt{\frac{Q_{MAX}}{V}} \qquad (E)$$

In construction, a parabolic section is difficult and costly. For this reason the section is made with a combination of vertical and sloping sides.

A nomograph for the discharge of Parshall Flumes[1] is shown in Fig. 2, for flumes under free-flow conditions

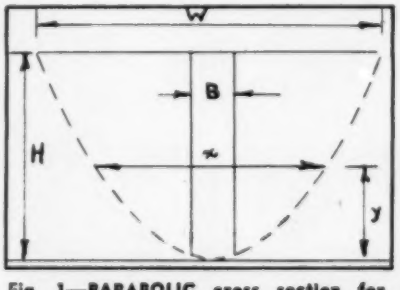

Fig. 1—PARABOLIC cross section for grit chambers to give a velocity of approximately 1 ft/sec for all flows.

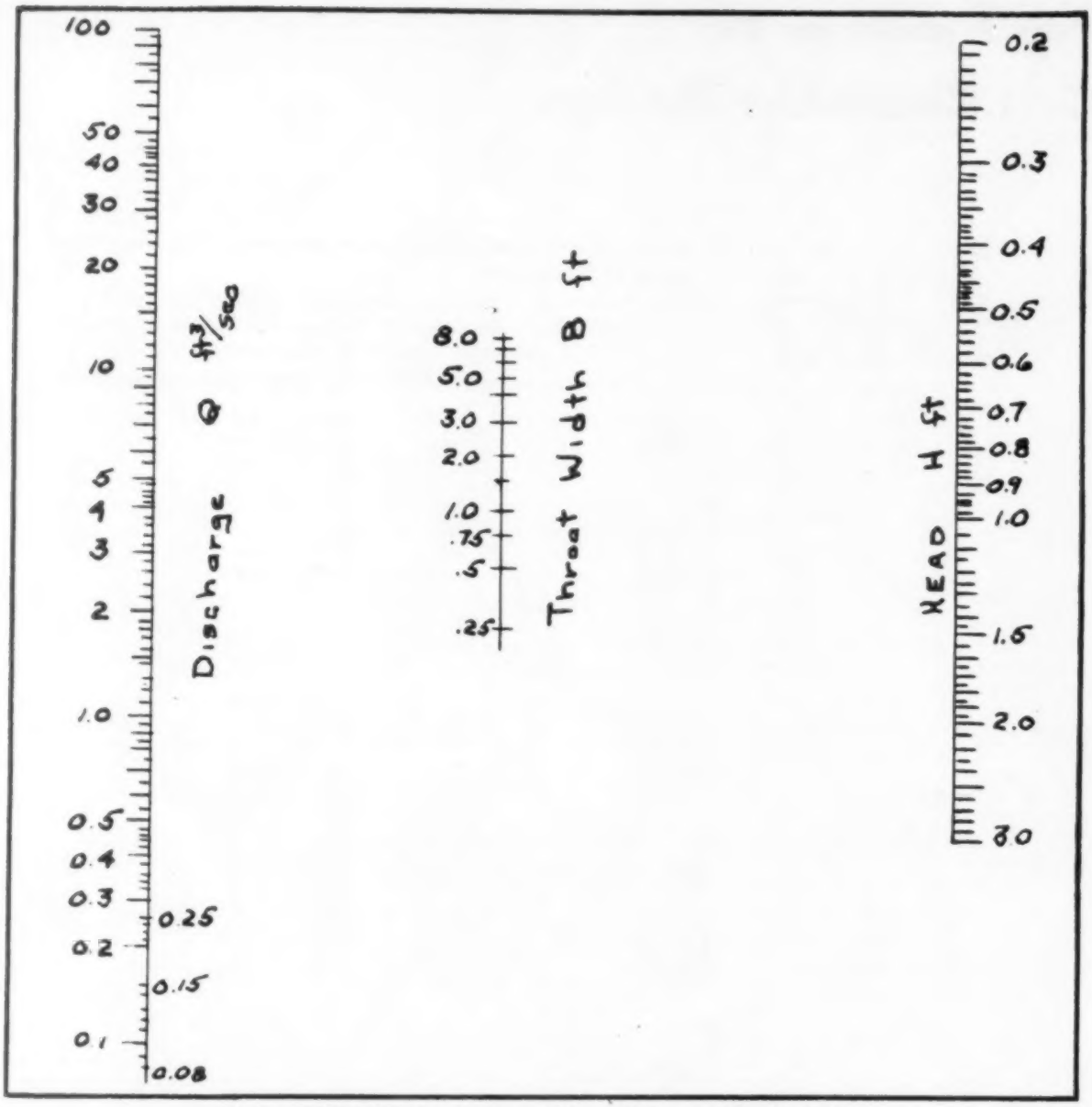

Fig. 2—NOMOGRAPH for discharge of Parshall flumes—After Muckleston

Based on $Q = 4\ BH^{1.522B^{0.026}}$ for flumes under free-flow conditions and under submerged head conditions when downstream head does not exceed 70 per cent of the upstream head.

TABLE 2

Dimensions for Parshall Flumes

B	A	C	D	E	F	G	K	M	N
0-9	2-10 5/8	2-10	1-3	1-10 5/8	2-6	1-0	1-6	0-3	0-4 1/2
1-0	4-6	4-4 7/8	2-0	2-9 1/4	3-0	2-0	3-0	0-3	0-9
1-4	4-9	4-7 7/8	2-6	3-4 3/8	3-0	2-0	3-0	0-3	0-9
2-0	5-0	4-10 7/8	3-0	3-11 1/2	3-0	2-0	3-0	0-3	0-9
3-0	5-6	5-4 3/4	4-0	5-1 7/8	3-0	2-0	3-0	0-3	0-9

and under submerged head conditions when downstream head does not exceed 70 percent of the upper head.

Figure 3 shows grit chambers with Parshall Flume. Table 2 shows the dimension data for Parshall Flumes. See Fig. 3 for letter key.

Procedure:

Example: Sloping Chamber with Parshall Flume (Fig. 3)

Data: average flow = 3 M.G.D. = 4.64 cu ft/sec

maximum flow = 6 M.G.D. = 9.28 cu ft/sec

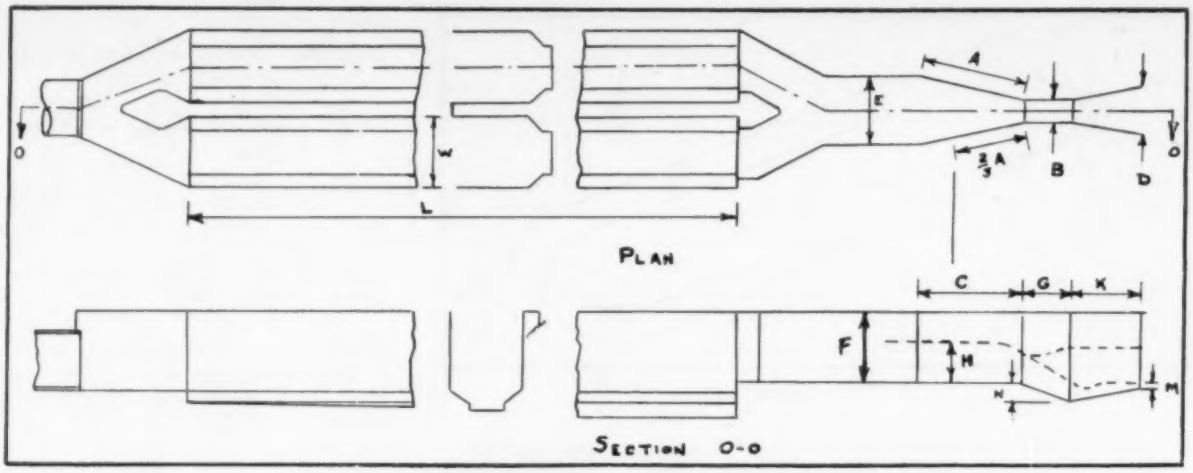

Fig. 3—GRIT chambers with Parshall flume.

minimum size particle to be removed = 0.2 mm.
two chambers
grit collected 5 cu ft/mil gal (Separate System)

1. Depth of Flow:

$$H_{MAX} = 1.1\sqrt{\frac{Q_{MAX}}{V}}$$

$$= 1.1\sqrt{\frac{9.82/2}{1}} = 2.37 \text{ ft}$$

2. Width:

$$W = 1.25\ H_{MAX} = 1.25(2.37)$$
$$= 2.96 \text{ ft—use 3 ft}$$

3. Length:

$$L = \frac{V}{v_o} H_{MAX} = \frac{1}{0.075}(2.37)$$

31.6 ft—Use 32 ft

4. Throat Width:

$$B = \frac{Q}{kH^{3/2}} = \frac{9.28}{3.5(2.37)^{3/2}} = 0.725 \text{ ft}$$

To avoid protective screens use a 1 ft-0 in. Parshall Flume. Dimensions for the Flume may be obtained from Table 2. Total grit chamber depth may also be obtained from this table.

5. Depth of Flow as determined by depth of water in flume: $H_{max} = 1.76$ ft.; $H_{avg} = 1.09$ ft. (from nomograph, Fig. 2). Theoretical shape of grit chamber:

$$x = \frac{3}{2}\frac{kB}{v}\sqrt{y} = \frac{3}{2}\frac{(3.5)0.5}{1}\sqrt{y}$$
$$= 2.63\sqrt{y}$$

The relation of y to x in this equation for various values of y is shown in this tabulation: (Fig. 1 and 4)

y	x
0.25	1.32
0.50	1.86
1.00	2.63
1.50	3.22
2.00	3.72
2.50	4.17

6. With a straight edge draw a trial cross section to approximate theoretical section—allow sufficient width at bottom for grit storage. Fig. 4a. Checking velocities for this cross-section:

$$V = \frac{Q}{A};\ V_{MAX} = \frac{9.28}{4.53x2} = 1.02 \text{ ft/sec}$$

$$V_{AVE} = \frac{4.64}{2.52} = 1.84 \text{ ft/sec}$$

7. The velocities may be made to approach the ideal by raising the outlet sill of the grit chamber (inlet to flume). This will increase the depth of flow and thus the cross-section in the grit chamber. Fig. 4b.

If the sill is raised 0.5 ft:

$$V_{MAX} = \frac{9.28}{6.03x2} = 0.77 \text{ ft/sec}$$

$$V_{AVE} = \frac{4.62}{4.03} = 1.14 \text{ ft/sec}$$

8. By varying the height of the sill and changing the side slope, the velocities may be brought within the limits. However, at lower flows, material might tend to adhere to the walls if the slope is too flat.

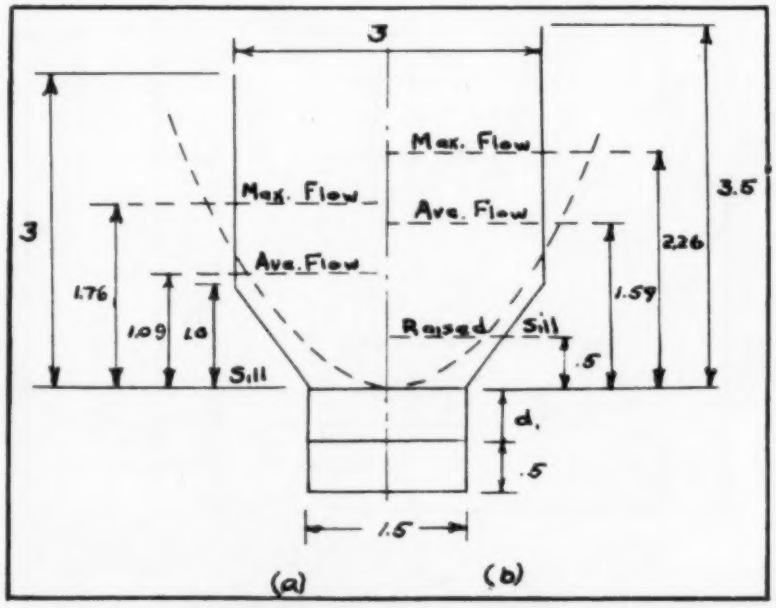

Fig. 4—APPROXIMATION of theoretical cross section for grit chamber.

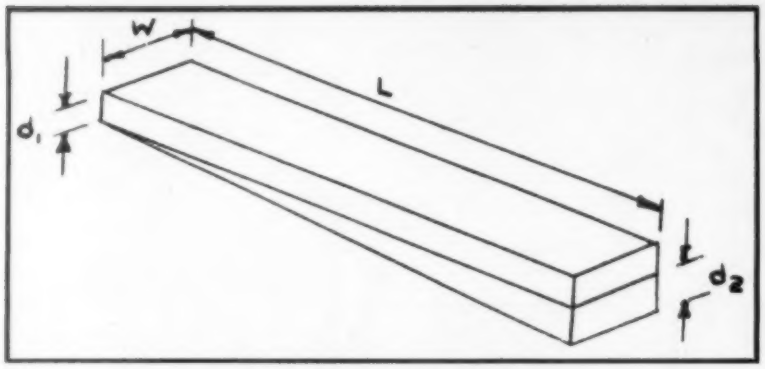

Fig. 5—GRIT storage section.

9. Overflow rate:

$$v_o = \frac{Q}{LW} = \frac{6{,}000{,}000}{32(3)\ 2} = 31{,}000 \text{ gal/day/sq ft}$$

which is well within the limits of 17,000 to 50,000

10. Grit Storage: (if cleaned every three days)

$5(3)\ (3) = 45$ cu ft for one chamber—See Fig. 5

$W = 1.5$, $L = 32$, $d_2 = 0.5$

$1/2\ (1.5)\ 32\ (.5) + 1.5\ (32)d_1 = 45$

$d_1 = 0.7$ ft

11. Scour Velocity:

$v_s = 1.3 \sqrt{(2.65\text{-}1)\ .2} = 0.748$ ft/sec

Our velocities will scour

Design of Grit Chamber with Rectangular Cross-section

CONTROL: *Proportional Weir*

The control for a grit chamber with a rectangular cross-section may be a proportional weir (Fig. 6). In order to insure proper operation, it is recommended that the sill of the weir be placed 6-12 inches above the invert of the grit chamber. Also the weir must not be submerged by tail water —this requirement necessitates a little more loss of head than with a Parshall flume.

The proportional weir maintains a nearly constant velocity in the grit chamber by varying the cross-sectional area of flow through the weir so that the depth is proportional to the flow.

For a proportional weir [2 5]

$$Q = C \times 1.57 \sqrt{2g}\ (w \sqrt{h})h$$

$$= 7.5\ (wh^{1/2})h$$

C— discharge coefficient (0.6)

Since the depth varies directly as the quantity, $wh^{1/2}$ must be constant. Hence for design

$$wh^{1/2} = k = xy^{1/2}$$

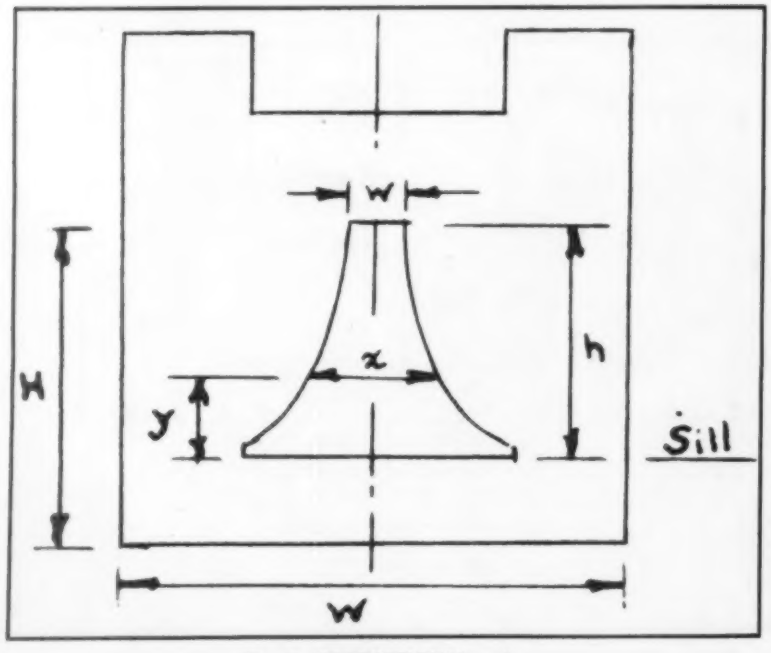

Fig. 6—PROPORTIONAL weir.

Procedure

Example: Rectangular Chamber with Proportional Weir

Data: Same as that used in previous problem

Unlike the Parshall flume where one flume handles the flow from several chambers, there must be one proportional weir at the end of each chamber. (Fig. 7).

1. From the size of particle to be removed, determine the overflow rate based on average flow (from Table 1).

Size Particle	Rate (g/d/sq ft)
0.28	38,000
0.2	(28,550)
0.17	25,000

2. With the overflow rate and the *average* flow, if *one* chamber, determine the surface area. If more than one chamber, use *maximum* flow divided by the number of chambers.

Using two chambers, design for 6/2 = 3 mgd

$$\text{Surface area } \frac{3{,}000{,}000}{28{,}550} = 105 \text{ sq ft}$$

3. From the surface area and an assumed width (or length) compute the length (or width). Check the (L/W) ratio.

Assume W = 2.5 ft

$$L = \frac{105}{2.5} = 42 \text{ ft}$$

$$L/W = \frac{42}{2.5} = 16.8$$

generally accepted limits. . . (15 to 30)

4. Check overflow rates for maximum and average flow.

$$\frac{3{,}000{,}000}{2.5\ \ (42)} = 28{,}600 \text{ g/d/sq ft}$$

generally accepted limits—17,700 to 50,000

5. Using Q = AV, determine the maximum depth of flow. Add Freeboard.

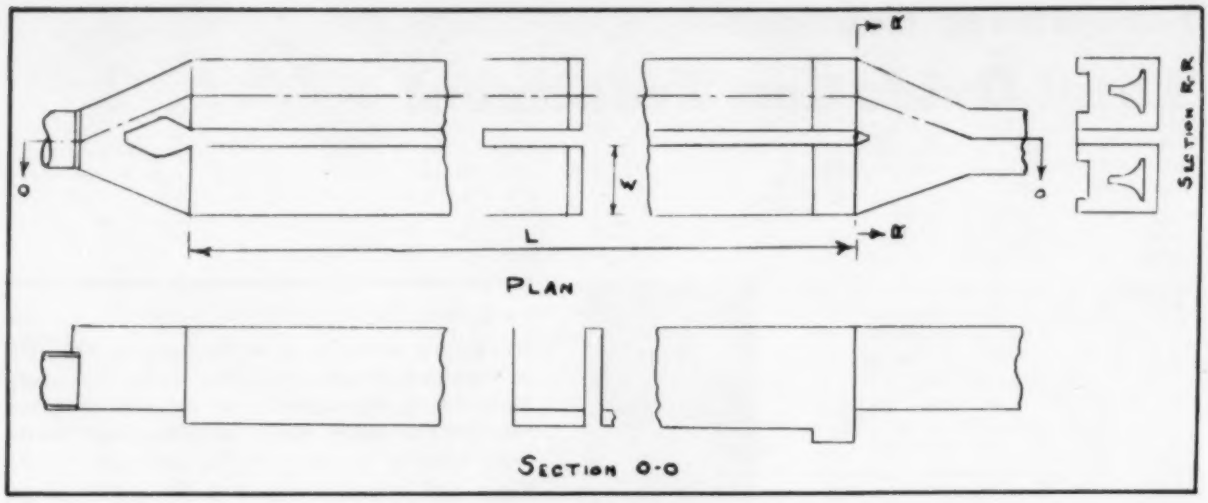

Fig. 7—GRIT chamber with proportional weir.

$$A = \frac{Q}{V} = WH$$

$$H_{MAX} = \frac{Q}{VW} = \frac{3 \times 1.547}{1 \times 2.5} = 1.855 \text{ ft.}$$

Allow for freeboard, make overall depth 3 ft.

6. Check L/H_{max} ratio

$$L/H_{MAX} = \frac{42}{1.855} = 22.6$$

generally accepted limits —— 17.1 to 36.7

7. Grit storage: (if cleaned every three days)

$$W = 2.5;\ L = 42;\ d_2 = .5;$$

For one chamber—$5(3)\ 3 = 45$ cu ft

$$\tfrac{1}{2}\ (2.5)\ 42\ (.5) + 2.5\ (42)\ d_1 = 45$$

$$d_1 = 0.18\text{—Say } 0.2 \text{ ft}$$

8. Assume a height of sill above the bottom of the grit chamber. (6-12 inches) and determine the maximum height of flow above sill.

Assume sill 0.5 ft above the bottom. Max. $h = 1.855 - 0.50 = 1.355$

9. Using $Q = 7.5(wh^{1/2})h$, compute w.

$$w = \frac{Q}{7.5\,h^{3/2}} = \frac{3 \times 1.547}{7.5(1.355)^{3/2}} = 0.392$$

Dimensions for this weir are shown in Fig. 8.

10. Using $k = wh^{1/2}$, compute k.

$$k = 0.392\ (1.355)^{1/2} = 0.455$$

y(in)	y(ft)	$y^{1/2}$	x(ft)
1	0.0833	0.290	1.570
2	0.167	0.409	1.112
3	0.250	0.500	0.911
6	0.500	0.708	0.643
9	0.750	0.866	0.525
12	1.00	1.000	0.455
15	1.25	1.118	0.407
16.26	1.355	1.164	0.392

11. The relation of x and y in this equation is shown in the following tabulation.

$$x = k/y^{1/2}$$

12. Total depth will depend on the design of the rectangular contract weir in top of the plate. This weir should be able to pass the total flow with some freeboard.

13. Terminate the side curves at h = 1 in. If terminated for h>1 in.

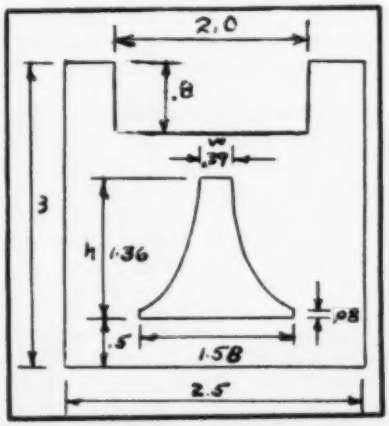

Fig. 8—DIMENSIONS for proportional weir in problem cited.

an allowance must be made for the reduced area by lowering the actual sill level (computations are based on theoretical sill level and need not be revised.) Terminate at 1 in.

14. Check velocity.

$$Q = 7.5\,kh \qquad V = \frac{Q}{WH}$$

Since two chambers—max. flow in two is same as average flow in one, and velocity equals one ft/sec.

As an example check velocity at 2.00 mgd.

$$Q = 7.5\,kh$$

$$h = \frac{Q}{7.5k} = \frac{2.0 \times 1.547}{7.5 \times 0.455} = 0.906$$

$$H = 0.906 + 0.500 = 1.406$$

$$V = \frac{Q}{WH} = \frac{2.0 \times 1.547}{1.406 \times 2.5} = 0.880 \text{ ft/sec.}$$

15. Scour velocity (same as for previous problems).

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For Sewage Consider—
Total Oxidation Treatment

by R. RUPERT KOUNTZ

Mr. Kountz is Professor of Sanitary Engineering at The Pennsylvania State University, University Park, Pa. In this article he sets forth some thought-provoking ideas on biological waste treatment by examining old concepts in new lights and applying old methods in new ways.

THIS is not an operating report of a pilot plant. This is not a statistical analysis of treatment plant data. There are no equations, no charts, no graphs. This is a philosophy and a discussion of a mechanism for the biological oxidation of sewage and wastes amenable to bio-oxidation. This is for the uninhibited sanitary engineer who can, and will think.

Based on B.O.D. Value

The first premise is the acceptance of the biochemical oxygen demand for its semantic denotation. If the B.O.D. is the oxygen used in the aerobic decomposition of pollution, then a bio-oxidation system must be designed for the magnitude of the B.O.D. value. If complete treatment utilizing total oxidation is desired, then the complete or ultimate B.O.D. becomes the design parameter.

But the B.O.D. test is based on the available *dissolved* oxygen; therefore, the treatment design must be based on *dissolving* a weight of oxygen equal to the ultimate B.O.D. weight. If the waste parameter for B.O.D. is pounds per day, then the oxygen supply design must be in pounds per day. The total oxidation treatment mechanism will be a giant extrapolation of the 20-day B.O.D. test for the waste concerned, and the end-products will be the basic compounds of biology—carbon dioxide, ammonia, and water.

Solids Removal Unnecessary

Assuming an extrapolation of the B.O.D. test to plant scale, there becomes no need to remove any solids before starting the oxidation. It will help, however, if the solids are shredded to a uniform small size before being oxidized. Gravity clarification will only serve to lower the O-R potential of the waste being treated, and inhibit the subsequent oxidation for a time.

There is no good reason for, nor evidence showing the benefit of removing the solids, except for the fact that they will settle if given the chance. Possibly in the days of inefficient devices like stone filter beds, this removal would imply a decrease in clogging. Thus, the second premise is established: solids removal is unnecessary.

An Intermediate Substance

Assuming the influent waste is now entering the oxidation tank (which, of course, by definition), must be continually aerobic, what happens? The organic pollution is enzymatically precipitated by the activated sludge biota and then absorbed for conversion into new activated sludge. This entire metabolic cycle requires four to six hours, depending on the temperature of the waste. Studies of this mechanism have been made (and reported in the literature) which show the yield of new activated sludge to be approximately one-half of the weight of the 20-day B.O.D.

The mechanism now has one phase defined: The input substance rate is related to the production rate of an intermediate substance. The third premise is thus established.

Excess Sludge Production and Removal

What is known of the activated sludge bio-mechanics or metabolism? In conventional plants, "excess" activated sludge is wasted from the system as "excesses" accumulate. Why? Because if it were all returned to the process the oxygen requirement would exceed the aeration capacity of the plant (as presently designed) and anaerobiosis would result.

Suppose the aeration capacity were increased, and all of the sludge were returned. What would happen? Nothing unfavorable to the process, except that the sludge concentration would cease to increase after five or six days. The equilibrium in sludge concentration results because the sludge (which is pure synthetic protein) undergoes oxidation, being converted to its fundamental component compounds. This oxidation rate approximates 20 percent (by weight) per day at 80° F., and occurs continuously in a system which is aerobic. Another phase of the mechanism is ascertained: the rate of removal of an intermediate substance from the process.

At this point in the theory development of the total oxidation process, a retrospective glance is in order: the intermediate product (activated sludge) has a known and definite rate of production and a known and definite rate of removal. These two can and do become equal, resulting in a daily sludge removal rate equal to its daily production rate.

The Oxygen Requirement

To any systems engineer, the only missing item is the energy input to the process. Since this is biological and aerobic, the energy is oxygen. How much oxygen must be supplied? Obviously, the amount supplied must be a weight equal to the 20-day B.O.D. if total oxidation treatment is desired. Unfortunately, the design process weakens at this point, as present aeration systems are rated in cubic feet of air or some empirical parameter of the manufacturer of a proprietary device.

The author has attempted to measure the weight of oxygen dissolved with various devices by operating them at different rates in a catalyzed sodium sulfite solution. These data have been reported previously in the literature. The weight of sulfite oxidized to sulfate should represent the maximum oxygen solution capacity of a device, and at least be compara-

ble to substrate with zero dissolved oxygen.

Through the cooperation of The Dow Chemical Co. the author was able also to apply this sulfite test to a patented corrugated Styron lattice known as Dowpac HCS. This material (having 25 sq. ft. of surface per cu. ft., and 94 percent voids) could create enough new surface for the liquid being recirculated over it (through 5-ft. vertical fall) so as to dissolve approximately ten times as much oxygen as the normal solubility of oxygen in water.

This presents amazing possibilities for a new style of mechanical aerator. For example, the application of 25 gpm per sq. ft. of top surface could dissolve 2.5 lb., of oxygen per day in the liquid being recirculated.

Translating these data to 100 lb. of dissolved oxygen per day (147 lb. of 5-day B.O.D.), the power requirement with Dowpac HCS should not exceed 5 hp. With Penberthy injectors 10 hp. would be required for this same weight of oxygen. Using porous air diffusers, 3 or 5 hp. probably would be required to dissolve this same weight of oxygen. According to one manufacturer of a mechanical aerator, one-half of this weight could also be dissolved with a single 5-hp. mechanical aerator.

Process Mechanism

To return to the theory of the process mechanism, it is obvious that only three process units are required: an oxidation tank; an oxygen supply; and a device for removing the activated sludge from the liquid, namely a clarifier. To review the facts and premises, the aeration tank must have a 6-hr. displacement capacity in order to complete the metabolic process, the oxygen supply per day must equal the 20-day B.O.D. weight per day, and the clarifier must be designed adequately for the maximum waste flow rate.

It is assumed that the engineer will ascertain that sufficient nitrogen is in the waste in proportion to the total organic content, and if not will provide for a supplementary supply; otherwise the process can never operate. It is further assumed that for strong wastes the engineer will design his system volume so as to have the equilibrium concentration of activated sludge not exceed 3,000 ppm in order to avoid hindering settlement, thus facilitating clarification.

A number of treatment plants have been built and are operating embodying these principles. Unfortunately the principles have been approached, in many cases, through over-design or by the use of large safety factors and hampered by the inhibition of using conventional systems and parameters. In the present era of high costs and expensive real estate the time has come to evaluate, and to design, waste treatment in the finite terms of a microbiological engineering process, rather than an electrified chrome-plated ox cart.

U. of Colorado Short School

Operators of public and private water and sewage treatment plants in the Rocky Mountain area attended a water and sewage plant operators school at the University of Colorado in Boulder, April 15 through 19.

Thirty-eight speakers from Wyoming and Colorado discussed such subjects as plant housekeeping, prevention of contamination in distribution systems, sludge digestion, construction grants for treatment works, and typical plant problems. Laboratory demonstrations, a film on public relations and a field trip were included in the school program. Reviews of mathematics, chemistry and bacteriology was also given to students of the water and sewage courses.

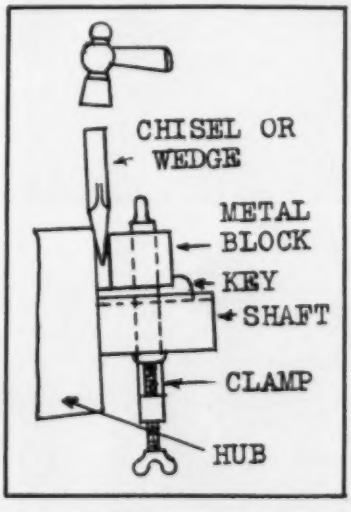
There were three courses offered: basic, water, and sewage. Supervisor for the basic course was William N. Gahr, director of sanitation, Colorado Dept. of Public Health; for the water course, George Prince, chief, Public Health Engineering Section, Colorado Dept. of Public Health; and for the sewage course, Jack Fooks, sanitary engineer, United States Public Health Service. Walter A. Weers, assistant professor of Civil Engineering, University of Colorado, acted as general chairman of the short school.

Registration will begin at 8:30 a. m., April 15 in the Chemistry Building on the campus of the University.

The school is offered annually in the chemistry Building of the University of Colorado. More than 100 persons attended. Co-sponsors of the short school are the Rocky Mountain Sewage Works Assn.; American Water Works Assn., Rocky Mountain Section; United States Public Health Service; Colorado Dept. of Public Health; Wyoming Dept. of Public Health; Colorado Municipal League; and the Colorado Water and Sewage Assn.

How to Pull a Tight Key

Here is a simple kink that the writer has found useful for pulling



tight keys. The drawing makes the operation practically self-evident. The metal block is shown thicker than necessary in order to illustrate the method more clearly. In fact it is better to use a thinner block than shown in order to lessen the overturning movement. Of course the exact arrangement as sketched need not always be strictly followed, there being a hundred and one variations of problems and as many solutions, all of which may be based on the same principle as illustrated here. The main idea is to use a metal block, the width of which is sufficient to leave a gap into which a chisel is driven for loosening the key.

Military Water Supply and Sanitation Symposium Report

Problems of water supply and sanitation encountered at advanced military bases are discussed by a symposium of military and civilian experts in a 418-page Navy volume available to industry.

Primary interest was in the standardization of equipment components, the coagulation problem in pretreatment of water, sewage disposal in arctic regions, and the serious difficulties caused by sealing in distillation equipment.

The report, PB 121037, Report of Symposium on Advanced Base Water Supply and Sanitation, may be obtained from OTS, U. S. Department of Commerce, Washington 25, D. C. Price is $7.00.

Proper Sludge Digestion

by JOHN L. WOOTEN
Superintendent
Sewage Treatment
Works
Carbondale, Ill.

A small plant operator's observations

IN A PROPERLY operating digester the sludge is digested completely in a period of 30 to 60 days into gases, liquids, mineral compounds, and nondigestible organic matter. When raw solids are placed daily into a digester, the material segregates into solids that settle to the bottom, a floating scum layer, and a zone of supernatant liquor between.

Raw sludge should be placed in the digester in as fresh a condition as possible. It is better to draw small amounts of sludge from the settling tanks often than to draw large amounts at longer intervals.

The digester works best when it is slightly alkaline. When pH falls below 7.0 the digester is beginning to be acid, a condition that may prove very troublesome. In any event, pH should never be allowed to go below 6.4, a condition that indicates undigested sludge. Various means of improving pH condition have proved successful, including recirculation, reduction of load, moderate liming, etc.

In addition to pH determinations, daily tests should include volatile acids determinations. If the volatile acids increase rapidly, the loading should be reduced until they tend to fall off. Then the loading should be increased only as much as will not greatly increase the volatile acids concentration. If these acids become very high (1,500 to 2,000 ppm), the tank should be rested until they are below 1,000 ppm.

For optimum results, digesters should be heated to between 95° and 100°F. However, on rare occasions good digestion has been obtained at 80° to 85°F. Digesters are heated either by circulating warm water through pipe coils in the digester or by circulating the sludge through coils in an external heat exchanger burning gas or oil. To prevent sludge from baking and caking on the coils, either in the heat exchanger or in the tank itself, the sludge temperature should not be allowed to rise above 130°F.

Supernatant liquor drawn from the digester should be returned to the head of the plant, provided the plant is not overloaded. In fact, the plant actually should be slightly overdesigned to handle this return with good results. Supernatant return to the plant should be over a long period, preferably 24 hours or longer.

Drawing of digested sludge to the drying beds should be at as slow a rate as is practicable so as to avoid pulling an inverted cone in the heavy material at the bottom of the tank. Such a method of operation would upset the unit by pulling out thin sludge or supernatant, leaving the thick bottom material, especially the silt and sand or solid inorganic matter. This could seriously reduce the tank volume available for active digestion. Sludge drawn for drying should not be placed on the beds at depths greater than 12 inches.

Sometimes the digester contents will not settle properly and the liquid is of the same consistency throughout the tank. This usually occurs when the digester is overloaded or when it is producing excessive gas. The condition can be remedied only by reducing the loading and resting the unit, if possible.

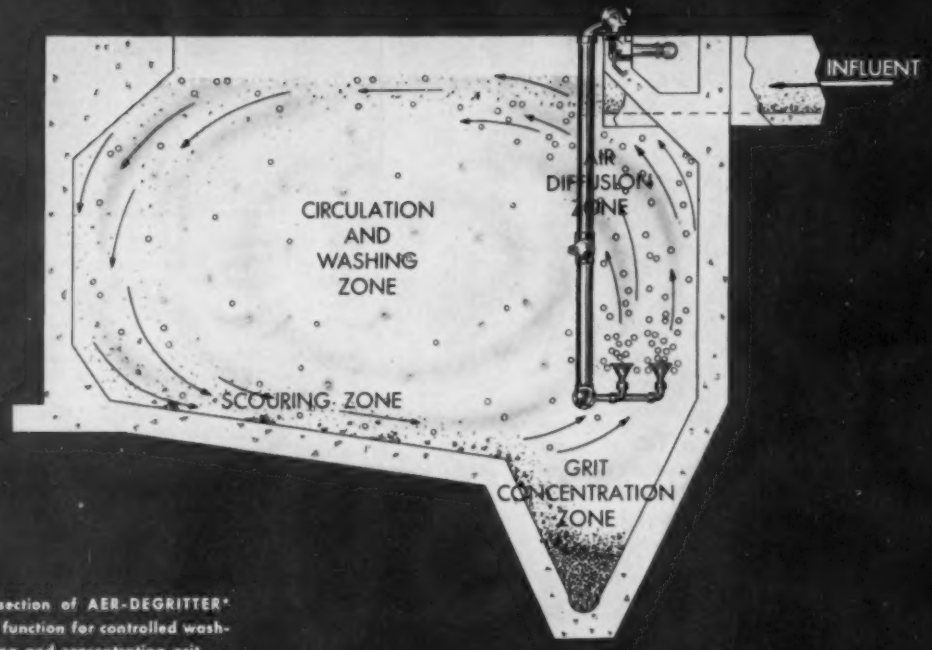
In summary, to control sludge digestion the digester contents should have a pH between 6.6 and 7.8 and the volatile acids content should be between 500 and 1,000 ppm. With proper provision for keeping the tank contents at a temperature of 95° to 100°F, the foregoing conditions should give excellent sludge treatment.

GENERAL VIEW of Carbondale, Ill., sewage treatment (upper photo) shows digester (left) and pumphouse (right) beyond primary settling tanks and aeration basins. Sludge beds are shown in lower photo.

"from Chicago"

The WHY and HOW of SUCCESSFUL AERATED GRIT REMOVAL

Through the *AER-DEGRITTER** Grit Removal System



Typical cross section of AER-DEGRITTER* showing basic function for controlled washing, transporting and concentrating grit.

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- ADEQUATE AIR DIFFUSION for controlled circulating velocities.
- CORRECT LOCATION OF AIR DIFFUSERS (unobstructed) directly over the hopper causes complete circulation of tank contents for grit washing and transporting across entire tank bottom into grit hopper. (Air diffusers in wrong location will "short circuit" bottom circulating velocities and cause uncontrolled grit and organic pile-up on tank bottom.)

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ONLY THE AER-DEGRITTER HAS A PROVEN RECORD OF SERVICE . . . OVER 150 INSTALLATIONS

*The application of the equipment, as well as the equipment itself is covered by U.S. Patents No. 2,532,457, No. 2,328,655, No. 2,555,201 and pending patent applications.

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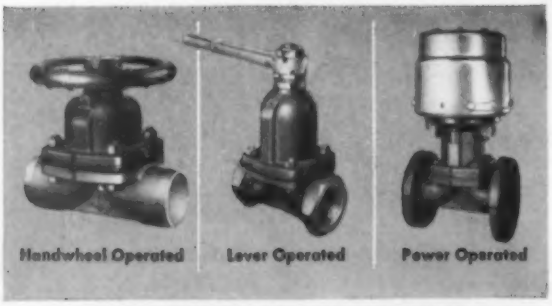

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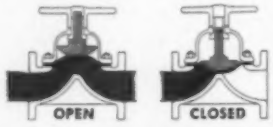

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Diaphragms — soft natural rubber, natural rubber; white synthetic rubber; neoprene; reinforced neoprene; butyl; Hycar; Teflon; Kel-F; PVC (polyvinyl chloride); polyethylene

Bonnets — iron; stainless steel; bronze; other materials on special order

Choice of Bodies

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Meetings Scheduled

1957

June 3-5—University, Ala. (*University of Alabama*)
ALABAMA WATER & SEWAGE ASSN., Secy., Prof. R. T. Tindall, Alabama Water & Sewage Assn., P. O. Box 1224, University, Ala.

June 3-7—Buffalo, N. Y. (*Hotel Statler*)
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th Street, New York 18, N. Y.

June 6—Newport, R. I. (*Viking Hotel*)
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Earl R. Howard, 115 Broad Street, Hartford, Conn.

June 6—Summit, N. J. (*Canoe Brook Country Club*)
NEW JERSEY SECTION, A.W.W.A., Luncheon and Summer Outing with Plant Inspection at Millburn, N. J., Secy., Albert F. Pleibel, 683 Prospect Street, Maplewood, N. J.

June 9-12—Seattle, Wash. (*Olympic Hotel*)
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Secy. F. J. Van Antwerpen, 25 West 45th Street, New York 36, N. Y.

June 12-14—Bedford Springs, Pa. (*Bedford Springs Hotel*)
PENNSYLVANIA SECTION, A.W.W.A., Secy., L. S. Morgan, Div. Engr., State Dept. of Health, Greensburg, Pa.

June 13—York Harbor, Maine (*Marshall House*)
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, 73 Tremont St., Boston, Mass.

June 16-21—Atlantic City, N. J. (*Chalfonte-Haddon Hall*)
AMERICAN SOCIETY FOR TESTING MATERIALS, Asst, Secy., Fred F. Van Atta, 1916 Race Street, Philadelphia 3, Pa.

June 17-18—Lake Placid, N. Y. (*Whiteface Inn*)
N. Y. SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Ralph C. Sweeney, c/o State Dept. of Health, 21 North Broadway, White Plains, N. Y.

June 17-19—Winnipeg, Canada (*Royal Alexandra Hotel*)
CANADIAN SECTION, A.W.W.A., Secy., A. E. Berry, 72 Grenville St., Toronto, Ontario, Canada

June 19-21—Dayton, Ohio (*Hotel Miami*)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE, Secy., Ward E. Conrad, 301 Ohio Departments Bldg., Columbus 15, Ohio

June 19-21—Des Moines, Iowa (*Hotel Kirkwood*)
IOWA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., L. F. Skorczeski, 207 S. 15th Avenue, Marshalltown, Iowa

June 20—Castine, Maine (*Maine Maritime Academy*)
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

June 24-28—University Park, Pa. (*Pennsylvania State Univ.*)
SEVENTH ANNUAL PENNSYLVANIA SEWAGE WORKS SCHOOL, Clifford V. Smith, Jr., Dept. of Civil Engrg, The Pennsylvania State University, University Park, Pa.

June 26-28—Chicago, Ill. (*Sherman Hotel*)
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Geo. F. Bernauer, 713 Chapman St., Madison 5, Wis.

July 8-12—University Park, Pa. (*Pennsylvania State Univ.*)
SEVENTH ANNUAL PENNSYLVANIA WATER WORKS SCHOOL, Clifford V. Smith, Jr., Dept. of Civil Engrg. The Pennsylvania State University, University Park, Pa.

Aug. 8—Greenville, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Aug. 12-16—Blacksburg, Va. (*Va. Polytechnic Institute*)
VIRGINIA SHORT SCHOOL FOR OPERATORS WATER & SEWAGE TREATMENT PLANTS, W. A. Parsons, Assoc. Prof. San. Engr., Va. Polytechnic Institute, Blacksburg, Va.

Aug. 26-28—University Park, Pa. (*Pennsylvania State Univ.*)
PENNSYLVANIA WATER WORKS OPERATORS' ASSN., Secy., Harry A. DeWire, 29 Chestnut Street, Lewistown, Pa.

Aug. 28-30—University Park, Pa. (*Pennsylvania State Univ.*)
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., J. R. Harvey, c/o Pennsylvania Dept. of Health, 916 Diamond, Meadville, Pa.

Sept. 4-6—Milwaukee, Wis. (*Hotel Schroeder*)
WISCONSIN SECTION, A.W.W.A., Secy., Harry Breimeister, Chief Utility Engr., City Engineer's Office, City Hall, Milwaukee 2, Wis.

Sept. 11-13—Upper Saranac Lake, (*Saranac Inn*)
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, Rensselaer Valve Co., c/o Ludlow Valve Co., 11 W. 42nd St., New York, N. Y.

Sept. 11-13—Sioux Falls, S. D. (*Sheraton-Cataract Hotel*)
23RD ANNUAL SOUTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Secy., Charles E. Carl, S. D. Water & Sewage Works Conference, Pierre, S. D.

Sept. 15-18—Boston, Mass. (*Hotel Statler*)
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, N.E.W.W.A., 73 Tremont St., Boston 8, Mass.

Sept. 15-18—Baltimore, Md. (*Lord Baltimore Hotel*)
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Secy., F. J. Van Antwerpen, 25 West 45th Street, New York 36, N. Y.

Sept. 18-20—Cincinnati, Ohio (*Netherland Plaza Hotel*)
OHIO SECTION, A.W.W.A. Secy., M. E. Druley, Dist. Mgr., Dayton Power & Light Co., Wilmington, Ohio

Sept. 23-25—Louisville, Ky. (*Brown Hotel*)
KENTUCKY-TENNESSEE SECTION, A.W.W.A., Secy., J. Wiley Finney, Jr., Howard K. Bell, Cons. Engrs., 553 S. Limestone Street, Lexington, Ky.

(*Jointly With*)

KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSN., Secy., S. Leary Jones, Cordell Hull Bldg., Nashville, Tenn.

Sept. 24-25—Santa Fe, N. M. (*La Fonda Hotel*)
ROCKY MOUNTAIN SECTION, A.W.W.A., Secy., Jack W. Davis, Dist. Mgr., Transite Pipe, Johns Manville Sales Corp., 301 Continental Oil Bldg., Denver 2, Colo.

Sept. 25-26—Stillwater, Okla. (*Oklahoma A & M College*)
OKLAHOMA INDUSTRIAL WASTES CONFERENCE, Prof. Quintin B. Graves, Oklahoma A & M College, Stillwater, Okla.

Sept. 25-27—Detroit, Mich. (*Leland Hotel*)
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Velde, Chief, Sec. of Water Supply, State Dept. of Health, Lansing 4, Mich.

Sept. 25-27—Fargo, N. D. (*Gardner Hotel*)
NORTH CENTRAL SECTION, A.W.W.A., Secy., Leonard N. Thompson, General Manager, Water Dept., St. Paul 2, Minn.

(*Jointly With*)

NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE, Secy., Jerome H. Svore, c/o State Dept. of Health, Bismarck, N. D.

Sept. 29-Oct. 1—St. Louis, Mo. (*Hotel Sheraton Jefferson*)
MISSOURI SECTION, A.W.W.A. AND MISSOURI WATER & SEWAGE CONFERENCE, Joint Meeting, Secy., Warren Kramer c/o State Office Bldg., 6th Floor, Jefferson City, Mo.

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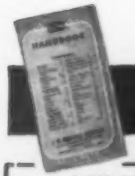

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Oct. 7-10—Boston, Mass. (*Hotel Statler*)
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSNS., Ralph E. Fuhrman, Exec. Secy., 4435 Wisconsin Ave., N. W., Washington 16, D. C.

Oct. 10—South Paris, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Oct. 13—16—Oklahoma City, Okla. (*Municipal Auditorium*)
SOUTHWEST SECTION, A.W.W.A., Secy., Leslie A. Jackson, Municipal Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 14-18—New York, N. Y. (*Hotel Statler*)
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wiseley, 33 W. 39th Street, New York 18, N. Y.

Oct. 16-18—Des Moines, Iowa (*Fort Des Moines Hotel*)
IOWA SECTION, A.W.W.A., Secy. J. J. Hail, Supt., Water Dept., City Hall, Dubuque, Iowa

Oct. 20-23—Biloxi, Miss. (*Buena Vista Hotel*)
ALABAMA-MISSISSIPPI SECTION, A.W.W.A., Secy., C. M. Mathews, Asst. Supt., Public Service Comm., 19 West Commercial Street, Yazoo City, Miss.

Oct. 23-24—Wheeling, W. Va. (*McLure Hotel*)
WEST VIRGINIA SECTION, A.W.W.A., Secy., Hugh W. Hetzer, Engr., West Va. Water Service Co., P. O. Box 1906, Charleston 27, W. Va.

(*Jointly With*)

WEST VIRGINIA SEWAGE & INDUSTRIAL ASSN., Secy., G. O. Fortney, c/o State Dept. of Health, Charleston 5, W. Va.

Oct. 24-26—Atlantic City, N. J. (*Hotel Madison*)
NEW JERSEY SECTION, A.W.W.A., Secy., Albert F. Pleibel, 683 Prospect Street, Maplewood, N. J.

Oct. 24-26—Seattle, Wash. (*Franklin Hotel*)
PACIFIC NORTHWEST SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Gilbert H. Dunstan, State College of Washington, P. O. Box 176, Pullman, Wash.

Oct. 28-30—Toronto, Ontario (*King Edward Hotel*)
CANADIAN INSTITUTE ON SEWAGE & SANITATION, Secy., Dr. A. E. Berry, Administrative Office, 72 Grenville St., Toronto, Ontario, Canada

Oct. 29—Nov. 1—San Jose, Calif. (*Civic Auditorium*)
CALIFORNIA SECTION, A.W.W.A., Secy., Henry J. Ongerth, Bureau of San. Engr., 905 Contra Ave., Berkeley 7, Calif.

Oct. 30-Nov.1—Washington, D. C. (*Sheraton-Park Hotel*)
CHESAPEAKE SECTION, A.W.W.A., Secy., Carl J. Lauter, 6955—33rd St., N.W., Washington 15, D. C.

Nov. 6-8—Roanoke, Va. (*Hotel Roanoke*)
VIRGINIA SECTION, A.W.W.A., Secy. J. P. Kavanagh, District Manager, Wallace & Tiernan, Inc., 213 Carlton Terrace Bldg., Roanoke, Va.

Nov. 7-8—Hastings, Neb. (*Clark Hotel*)
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., V. J. Lechtenberg, 614 Standard Oil Bldg., Omaha, Neb.

Nov. 11-13—Raleigh, N. C. (*Hotel Sir Walter*)
NORTH CAROLINA SECTION, *A.W.W.A.*, AND NORTH CAROLINA SEWAGE & INDUSTRIAL WASTES ASSN., Joint Meeting, Secy. Wilbur E. Long, Jr., 1615 Bickett Blvd., Raleigh, N. C.

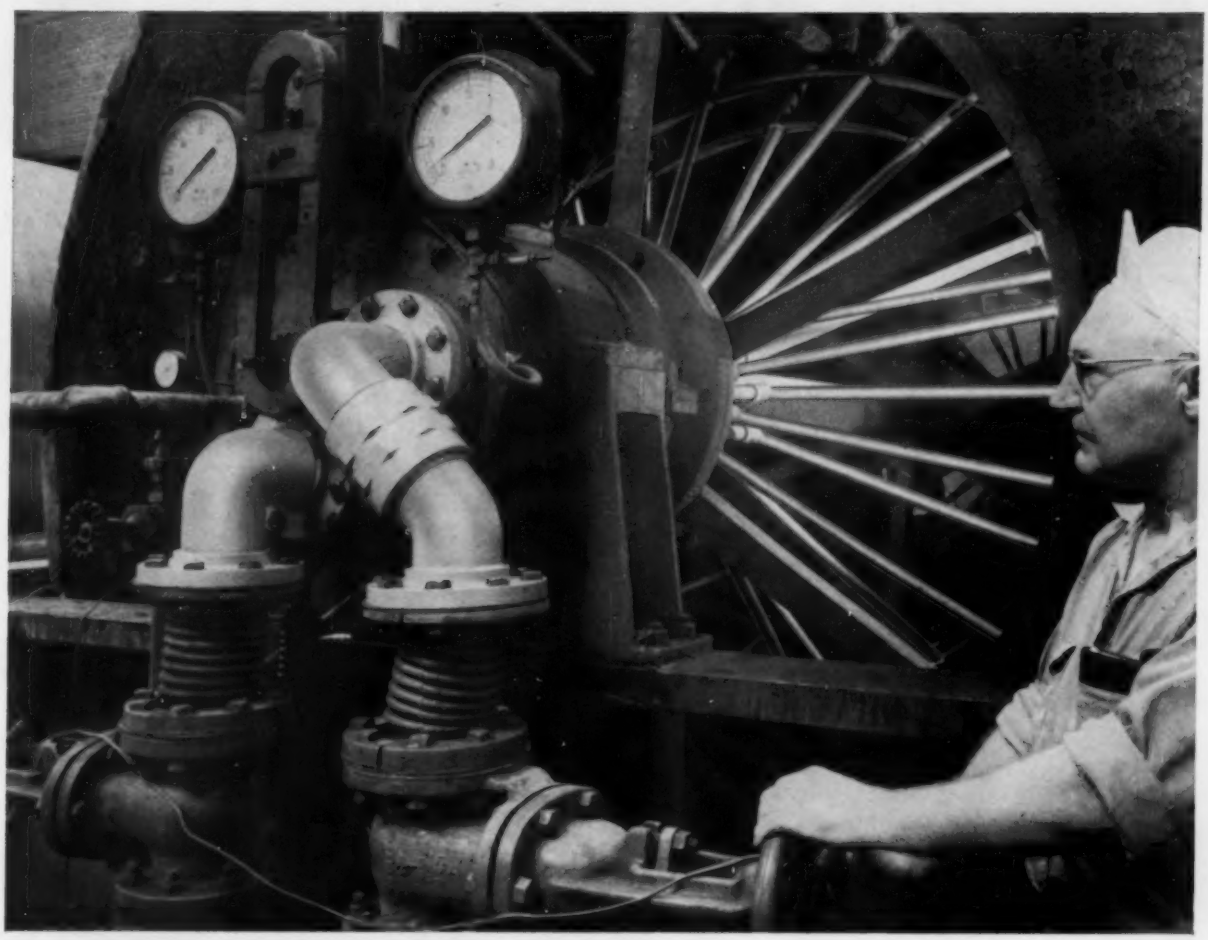
Nov. 11-15—Cleveland, Ohio
AMERICAN PUBLIC HEALTH ASSOCIATION, 85th Annual Meeting, Exec. Director, Dr. Reginald M. Atwater, 1790 Broadway, New York 19, N. Y.

Nov. 18-22—Stillwater, Okla. (*Oklahoma A & M College*)
OKLAHOMA WATER & SEWAGE SHORT COURSE, Prof. Quintin B. GRAVES, Oklahoma A & M College, Stillwater, Okla.

Nov. 21—Boston, Mass. (*Hotel Statler*)
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, 73 Tremont St., Boston, Mass.

Dec. 1-6—New York, N. Y.
AMERICAN SOCIETY MECHANICAL ENGINEERS, 29 West 39th Street, New York, N. Y.

USCOLITE PLASTIC PIPE



Pipeline of one of the Seven Wonders of American Engineering

Chicago's 403-million-dollar sewage disposal system every day processes 1200 million gallons of raw sewage. It's regarded by authorities as one of the seven engineering wonders of the nation.

Imagine the damaging effect on pipe of ferric chloride and other acidic chemicals used in the process! But this is not ordinary pipe in Chicago's great sewage disposal system. It is *Uscolite® Plastic Pipe.*

Uscolite Plastic Pipe was installed some eight years ago. Since then not a single leak has developed, not even a sign of weakness. The metal pipe it replaced had in some places been reduced to the thickness of a thumbnail!

The above rotary filter is but one of ninety-eight in the system. Each filter is 16 feet long, 11½ feet in diameter, contains 820 feet of 1" Uscolite Plastic Pipe and hundreds of Uscolite nozzles and additional fittings.

Uscolite Pipe and fittings are obtainable at our 28 District Sales Offices—each staffed with factory-trained engineers, at selected distributors, or write us at Rockefeller Center, New York 20, N.Y. In Canada, Dominion Rubber Co., Ltd.

NATIONAL SANITATION FOUNDATION SEAL OF APPROVAL AWARDED TO USCOLITE PIPE

Mechanical Goods Division

United States Rubber

W&SW

Spillway

OVERFLOW FROM THE MAIN SECTION

Pickups from Purdue's "Sanitary Engineering News"

To reduce digester size and increase the operating efficiency, the new Steubenville, Ohio, sewage treatment plant wrapped its two digesters in an insluating coat of cellular glass.

* * *

At Columbus, Ind., three city employees were injured by a sewer gas explosion in a small sub-station. The explosion was heard for ten blocks and manhole covers were blown into the air three blocks from the pumping station. Lighting a cigarette is blamed for setting off the explosion.

* * *

During 1954 Gary, Ind., used 901 cu. ft. of air per pound of B.O.D. removed in its activated sludge plant.

* * *

Leasing waste treatment facilities affords the user the same use of these assets as though he had bought them outright. The yearly payments of the operating company or user to the lessor becomes a fixed rental charge which is a wholly deductible expense out of gross profits before taxes.

* * *

A piece of glacial wood found in the city well in Edwardsville, Ill., has been identified as being more than 21,600 years old.

* * *

A report from Chicago says that the chlorine in water may cause corrosion of the impellers of pumps discharging freshly chlorinated water.

* * *

It is worth repeating—maintenance is a vital factor in the proper management and operation of all water, sewage and waste treatment systems and works.

Detroit Selects Adjustable Blade Pumps

Adjustable blade pumps form the major portion of a $1,765,000 contract recently awarded by the Department of Water Supply of the City of Detroit, Michigan, for the city's new raw water booster pumping station at Water Works Park.

The four 60" adjustable blade pumps, are each rated at 250 million gallons per day, will be driven by 3500 hp electric motors.

An existing concrete-lined 14 ft. diameter tunnel presently furnishes a major portion of the city's water supply by gravity flow, but current demand has exceeded this supply. To increase the flow in this tunnel, the city is building the booster pumping station which will render the existing tunnel adequate to meet the growing water demands for some time to come.

Adjustable blade pumps were selected for this application because the discharge of each pump can be varied to meet any requirements from zero flow to maximum capacity. This feature permits a constant pressure to be maintained in the tunnel under varying flow conditions and without surging.

This Sewer Cleaning Operation Used To Take Two Men

The helper that was needed on this job to dump the bucket, is now released to handle other sewer maintenance problems. The Sewer Department has literally gained another man *at no extra cost.*

It's the new Automatic Bucket Dumper that does the trick. In 30 minutes, for less than 2 weeks wages, it can be installed on all existing "Flexible" Bucket Machines. And, of course, before any new Bucket Machines are purchased, you should get the full *Automatic Bucket Dumper* story.

FLEXIBLE INC.
3786 Durango Ave., Los Angeles 34, Calif.
(Distributors in Principal Cities)

To learn more about this latest in a long line of "Flexible" firsts, write for the name of your nearest distributor.

Other advantages of adjustable blade pumps over mixed flow pumps emphasized by engineering analysis of this project included the following: four units required rather than eight; housing structure reduced from 150′ diameter to 90′ diameter; elimination of a twelve and a half million gallon surface reservoir; automatic flow control without surging and good efficiency over complete operating range.

Low bidder on the Detroit pumps and butterfly valve installation was S. Morgan Smith Co. of York, Pa.

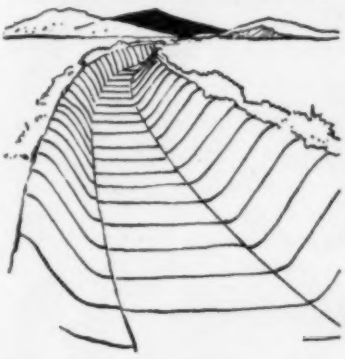
"The Fight For Fluoridation"

"The Fight for Fluoridation," published by Oxford University Press tells the dramatic story of a controversy that began as a matter of aesthetics and has now grown into a great question of national health: whether fluoride, "Nature's tooth decay preventive," should be used in drinking water. The book was authored by Donald R. McNeil, Associate Director of the Wisconsin State Historical Association. A graduate of the University of Oregon, he received his M. S. and Ph. D. degrees in History from the University of Wisconsin. He is the author of "The American Collector."

According to the author, more than two hundred nationally known organizations have endorsed fluoridation, yet it remains a controversial subject, even in some of the cities where it has been adopted. Opponents denounce it as a potential killer, a violation of individual rights, and the first step toward socialized medicine. Proponents see whole generations losing the benefits of an inexpensive chemical which in the proper proportions, they say, would improve the dental health of America's children by lowering the decay rate 60 to 70 per cent. Opponents retort that it is better to have poor teeth and good health than to imbibe a deadly poison.

Dr. McNeil chronicles the years of research which followed the first investigation of "Colorado brown stain," in 1902 when Dr. Frederick S. McKay, a young dentist in Colorado Springs, became interested in what caused the ugly, stained teeth in his community. Dr. McNeil has written a technically accurate and interesting history of the research that preceded fluoridation and the struggles that have surrounded it as a public health measure. According to the publisher, his story suggests parallels with the fights for vaccination and pasteurization.

. . . insure the *COMPLETE* containment of water, wastes, sludges and sewerage in . . .



- **IRRIGATION PROJECTS**
- **INDUSTRIAL RESERVOIRS & WASTE CONTROL PONDS**
- **MUNICIPAL WATER AND SEWERAGE PROJECTS**
- **MILITARY INSTALLATIONS**

"Hydromat" hydraulic mats, developed and manufactured by the leading manufacturer of asphaltic products for over 30 years, were developed in a scientific manner to provide a lining material that would allow the COMPLETE containment of water, wastes, sludges, sewerage, etc. "Hydromat" is installed as a monolithic liner, with mechanically sealed joints, that will expand and contract with soil movements without rupturing or breaking the seal. "Hydromat", a fully exposed type of lining, may be installed quickly and easily by untrained labor . . . make-ready requires only a minimum of time and effort. "Hydromat" provides the practical answer to the problem of efficiently relining old, cracked concrete or gunite linings. "Hydromat" hydraulic mats are produced in sheet sizes 4′ wide up to 12′ long . . . available in thicknesses of 5/32", 1/4" and 1/2".

WRITE TODAY!

WRITE TODAY . . . for your copy of our "Hydromat" TECH-TIPS covering complete technical data on the uses and installation of "Hydromat" Asphalt Liners.

W. R. MEADOWS, INC.

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• For further information on products or services please use reader service card.

W&SW

New Equipment

Automatic Tank Selector System

601

Mason-Neilan, Div., Worthington Corp., Norwood, Mass., has developed a new automatic tank selector system for controlling the filling of storage and settling tanks.

The ATS system uses a pneumatic circuit, with a selector-controller and level transmitters directing operation of pneumatic fill valves. The system is said to be extremely accurate, reliable and economical.

In operation the ATS selector-controller automatically senses the liquid level of each tank in the system through the level transmitter and then automatically opens the fill valve if tank requires filling, or automatically cycles to next tank if filling is not required. This is the scanning operation which can be continuous or intermittently cycled as needed, requiring only one second per tank. Each ATS circuit can handle up to twelve tanks and two or more selectors can be connected in series to control any number of tanks.

Corrosion Protected Amseal Joint Rings

602

American-Marietta Co., Chicago, Ill., has announced that the company's Amseal ring joints, for use with large concrete water and sewer pipes, are being positively protected from corrosive agents during storage at construction sites, and after installation as part of a pipe line. This protection is accomplished by metalizing the steel joints with zinc. This process permits high speed production coating of all sizes ranging from 24 to 120 inches in diameter.

Flexible Shaft Terminals For Valve Control

603

The Stow Manufacturing Co., Binghamton, N. Y., has developed a completely new line of terminals for use with flexible shafting for the remote control of valves. By using these new standard terminals it is unnecessary to "cobble" up existing terminals, and valves can be controlled easily from a remote location.

The new couplings are designed to fasten to the valve handwheel spokes by "U" bolts. Any of the couplings can be obtained either with or without the quick disconnect attachment. After the couplings are fastened to the handwheels, the flexible shafts are fastened to the couplings by simply pinning the flexible shaft fitting to the spindle on the coupling.

The largest water tank repair company in the United States is at your service. Repairs guaranteed for 12 years—paint for 3 years.

Representatives in every state of the Union.

DIXIE TANK'S "SYMBOL" OF YOUR PROTECTION

DIXIE TANK & BRIDGE CO.

P. O. BOX 14, MEMPHIS 1, TENN.

Please write or wire us for more information.

Power Unit Converts A.C. Motors To Variable Speeds

604

U. S. Electrical Motors, Inc., Los Angeles, Calif., has developed a new Varidyne Power Unit, that makes it possible to convert any standard NEMA 3-phase A.C. induction motor from a fixed-speed motor into a variable speed drive without even removing it from its present installation.

By connecting the induction motor leads to the power unit, the motor will receive a variable frequency current generated by the power unit. Speeds are changed at the power unit by means of a handwheel, or remotely by mechanical or electrical remote controls.

Portable Sump Pump Resists Corrosion

605

Schramm, Inc., West Chester, Pa., bas developed a new, self-contained, air-powered, portable sump pump that has wide application in the removal of sewage, sludge, chemicals, etc.

The pump body, impeller, and strainer are made of bronze, to resist corrosion and to insure spark-free operation. As a result, chemical solutions and inflammable or explosive liquids can be handled safely.

Requiring no priming, the pump is ready for instant use. It is 19⅜ in. high and can be passed through

a hole as small as 9 by 11 in. Any liquid over 1-⅜ in. deep can be picked up. Solids over ¾ in. are blocked out by the integral bronze strainer.

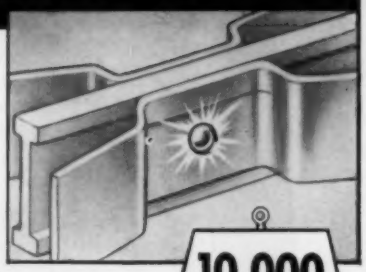
GOLD NUGGET®

WELDED grating

PAT. PENDING

Realizing the need for an improved heavy duty, open steel floor grating of greater strength and economy, The GLOBE Company presents GOLD NUGGET Welded Grating — the first grating to take advantage of modern engineering design. As a result of this improved design, the GOLD NUGGET primary load bar provides 22% more strength with 14% less weight. The primary load bar is a miniature I-beam with all of the advantages of a true structural member.

GOLD NUGGET Welded Grating is recommended for power houses, loading docks, oil refineries, fire escapes, drain grates, plating rooms, filtration rooms and for all types of heavy duty platforms.



GOLD NUGGET

- ★ ⅜" projection weld nugget for greater rigidity and strength
- ★ vertical alignment of the main load bars assured
- ★ all bars are load carrying bars including secondary bars
- ★ anti-skid pattern

10,000 POUNDS

PROJECTION WELD

Each secondary load bar (A), as projected welded to the primary load bar (B) has a shear strength of 5,000 pounds per weld. There are 28 such projection welds to a square foot of grating. This means that GOLD NUGGET Welded Grating can sustain greater shock loads than other gratings.

For the complete details of this revolutionary new grating, write for new catalog today. Distributors in all principal cities. Consult the yellow pages in your phone book under "GRATING."

The GLOBE Company MANUFACTURERS SINCE 1914

PRODUCTS DIVISION

SAFETY GRIP-STRUT GRATING • GOLD NUGGET WELDED GRATING • CABLE-STRUT AND GLOBETRAY CABLE RACEWAYS

4042 SOUTH PRINCETON AVENUE • CHICAGO 9, ILLINOIS

Waste Treatment Process For Small Plants

606

Dorr-Oliver Incorporated, Stamford, Conn., has announced the availability of the Dorr-Oliver SpiroVortex System for the complete treatment of domestic sewage and intermediate treatment of industrial wastes.

This newly developed treatment method operates on the same principle as the activated sludge process and will produce a treated effluent from which over 90% of the B.O.D. in the raw sewage has

been removed. Although particularly applicable to new plants treatment of one MGD or less, the system may be advantageously employed in the expansion of existing plants in which it is feasible to divide the flow to the secondary treatment stage.

In the SpiroVortex system, secondary treatment comprises aeration on a filter bed and two periods of contact time prior to secondary clarification plus extremely high recirculation rates. Operating power requirements are less than for other methods producing comparable results and the necessity of air diffused systems and highly trained operators is eliminated.

HTH

Tablets

go right down the line in sanitizing new water mains

That's literally true! And no treatment could be more efficient. One HTH Tablet, fastened to the top of the pipe interior with hot tar or a suitable gasket cement, will sanitize up to 30 feet of 4-inch pipe . . . starting the minute the water is turned on.

Complete sanitizing is assured! The tablets dissolve slowly, releasing available chlorine that spells sudden death to bacteria, fungi and algae on all interior surfaces of the pipe section.

And no chlorine is wasted or washed away since the tablets remain in place until their job is done.

Consider it from all angles—convenience, effectiveness and economy—and nothing equals HTH Tablets as a slow, steady source of 70% available chlorine for sanitizing new or newly repaired water mains. Olin Mathieson will gladly send you further information to help you take full advantage of this proved method.

HTH

HTH® is a trademark

OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

4826

Electric Manufacturing Building Motors For St. Louis

607

Electric Machinery Manufacturing Co., Minneapolis, Minnesota will build the motors for the large addition to the St. Louis, Missouri Chain of Rocks Pumping Station.

This Station, which supplies water for the City of St. Louis, is one of the largest water pumping stations in The United States.

Involved in the electrification project are 10 large synchronous motors with a total of 21,500 hp. The motors, with a high operating efficiency, are of a special design, being totally enclosed with top mounted air coolers.

The motors will drive 10 centrifugal pumps which will be furnished by the Worthington Corporation, the prime contractor for the plant expansion.

Multiport Valve For Hot Softeners and Filters

608

Hungerford & Terry, Inc., Clayton, N. J., has developed a new poppet type multiport valve for use with hot Zeolite softeners and hot anthracite filters following hot process lime softeners.

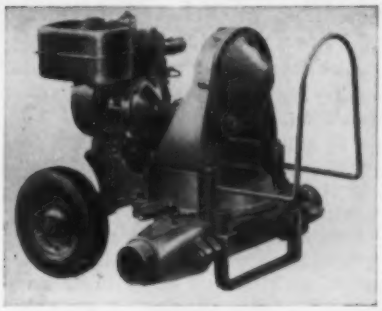
The multiport valve is designed and built especially for high temperature work of this type.

Lightweight Diaphragm Pump

609

The Ralph B. Carter Company, Hackensack, N. J. has announced a new addition to its line of Humdinger Pumps . . . a rugged, full capacity 3" unit weighing just 125 lbs. Designated as the Model 3 ADF, this lightweight, easy-to-handle pump is rated at 4200 G.P.H., although on gruelling maximum stroke tests, it actually handled over twice this capacity.

The pump body and housing are cast of high strength aluminum alloy, especially selected for resist-



ance to wear and abrasion. Streamlined waterways minimize internal friction . . . body design allows full displacement action of diaphragm, resulting in top capacity on every stroke.

The full swing check valves are made of durable neoprene compound . . . designed with oversize weights to insure positive seating on every stroke. Fittings are available in 2" and 3" IPS suction and discharge. Choice of power includes gasoline engine or electric motor drive.

Fisher Scientific To Sell Sabro Portable Labs

610

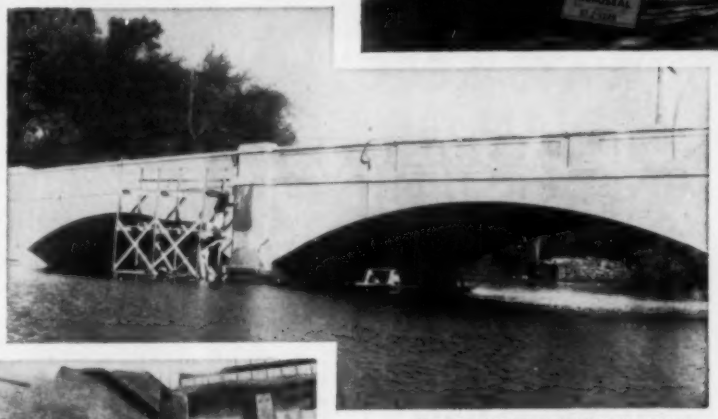
Fisher Scientific Co., Pittsburgh, Pa., has been named sales licensee for the Sabro Portable laboratory for water bacteriological analysis. This laboratory is supplied by the Hyla Division of Salem-Brosius, Inc., and Fisher will be the sole laboratory supply house offering the Sabro unit and allied equipment.

The Sabro laboratory has found extensive application among federal, state, municipal and private sanitary engineers in "on-the-spot" field testing of water purity. Also

the Sabro technique is accepted procedure at a number of U. S. Air Force bases in the United States and overseas.

It's *New Again* with THORITE and THOROSEAL

Freeze-thaw cycle following water and moisture penetration, also swelling of reinforcing rods from moisture contact, cause masonry destruction.



BRIDGE OVER CONCORD RIVER
ROUTE 3, BELLERICA, MASS.

Workmen on scaffold patch spalled and cracked concrete with THORITE and seal surface with THOROSEAL.

Area at left chipped to sound masonry. It will then be patched with THORITE *Nonshrink, Nonslump 20-Minute Set Patching Mortar*, without necessity of costly forming, finished by application of Thoroseal.

Request Circular No. 16 and 20.

Write for our 16 page "How to Do It"

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNSYLVANIA • CENTERVILLE, INDIANA

Arched Hoe Boom

611

Insley Manufacturing Corporation, Indianapolis, Indiana, is now offering optional arched hoe boom attachments for both the Type K and Type L machines. Both booms are of the same design and have two vertical sheaves near the boom mid-point and an enclosed horizontal sheave at the bucket.

The arched hoe boom attachment for the Type K machine has a 16 ft. 9 in. boom, 10 ft. 2 in. arm (hinge pin to bucket teeth), and a digging depth of 17 ft. 6 in.

The arched hoe boom attachment for the Type L machine has an 18 ft. 9 in. boom, 10 ft. 2in. arm (hinge pin to bucket teeth), and a digging depth of 19 ft. 3 in.

New Line of Valve Actuators

612

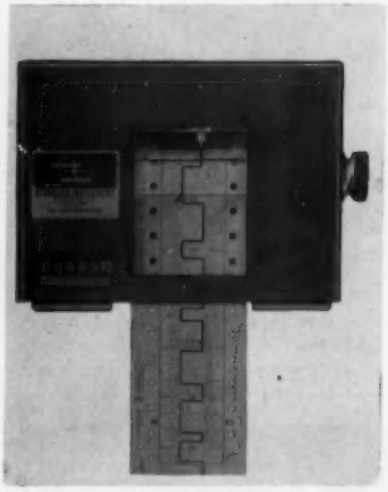
Robertshaw-Fulton Controls Company, Knoxville, Tenn., has developed a complete line of all-metal actuators for control valves for use under difficult conditions such as atomic radiation, high temperatures and corrosion.

For use in highly corrosive atmospheres, one model is manufactured with stainless bellows and stem. Its frame is made from cold rolled steel which has been cadmium plated. It is available in three ranges of signal pressures: 3 to 15 PSI; 6 to 30 PSI, and 9 to 45 PSI. Possessing a maximum thrust of about 3,000 pounds, the actuator is compact in size, measuring 17 9/16 inches in length and 8⅝ inches in diameter. One unit, available "air to close" only, is fabricated completely of stainless steel.

Recorder-Totalizer

613

Standard Instrument Corporation, New York, N. Y., has developed the model "SR" recorder-totalizer.



Some of the features of the instrument include: continuous sprocket driven strip chart; continuous recording chart rolls contain 250 lineal feet of continuous, chronologically printed chart; chart rolls are available in a variety of speeds from 1 inch per hour to 10 inches per minute; elapsed time meter that registers accumulated "on" time; a transparent autograph access window that allows viewing of the recorded chart, and can be lifted to provide sufficient area for making notations directly on the chart; and an external chart time setting knob for setting the chart to the correct time of day.

ALWAYS-READY
GUARDIAN OF *LIFE*
AND PROPERTY

MH

COMPRESSION TYPE
FIRE
HYDRANT

Above: Standard Model.
Below: Traffic Model.

Although an M & H Fire Hydrant may stand idle for years, without a moment's notice it functions perfectly. Its simple rugged design and careful manufacture from highest quality materials is the reason.

Large diameter, unobstructed waterway gives high flow efficiency when large volume of water is needed to fight fire. All operating parts are bronze or bronze bushed. Furnished either in accordance with A. W. W. A. specifications or Underwriters and Factory Mutuals approved; also either standard model, traffic model or flush type. For complete information, address

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF W WALWORTH

Roto—Rooter Equipment Features Automatic Transmission

614

Roto-Rooter Corporation, Des Moines, Iowa, has announced that their sewer, drain and pipe cleaning equipment is now provided with an automatic transmission featuring a Mercury clutch of comparatively moderate cost.

With the application of the Mercury clutch, the company has been able to achieve smoother starts, to eliminate overload on motors and engines and to avoid blown fuses in electrical installations. The fluid drive action provided by the Mercury clutch revolves loaded reels of from 40 to 500 pounds with smooth positive starts, assuring greater efficiency and longer life for each machine.

Root Destroyer

615

Camp Chemical Co., Inc., Brooklyn, N. Y., has developed a Sewer-Cide root destroyer which kills and prevents roots in sewer lines and root blocked sewers.

The product is said to be harmless to trees and shrubs, and one treatment will last a year. Sewer-Cide can be used in cesspolls and septic tanks. It is different than most chemicals used for root control because it dissolves very slowly, sending its toxic chemicals to the tree roots where it is absorbed into the root system.

Sewer-Cide may be used as a preventive, or as a killer, it is flushed into the sewer through the nearest opening to the point of blockage.

Motor Protecting Relay

616

Electrical Service Company, Greenville, Texas, has developed a precision instrument that unfailingly protects any three-phase, induction motor against failure due to shaft overload, voltage unbalance, and/or single phasing.

The motor protecting relay employs the basic principles of symmetrical components to effect a drop-out of any motor that approaches the stage of dangerous overheating from either one or any combination of all three above mentioned faults. It is manufactured to extremely close tolerances, to meet the nameplate data of the motor for which it is intended; and is available in any of the standard NEMA type enclosures.

and sewage in...

with Ropax®

non-porous joint packing

When ground water seeps through your sewer pipe joints, it can result in an overtaxed system, needless expense and labor.

ROPAX is a non-porous, adhesive joint packing designed to minimize this problem. It compresses and conforms snugly to the contour of the pipe bell, forming a solid seal against water passage.

KALKTITE®, Presstite's service-proved, cold-applied asphaltic joint cement, then forms a dense, tough, flexible seal that cuts infiltration to a minimum. It sets up internally, unaffected by hot, cold, wet or dry conditions.

WRITE for PRESSTITE CATALOG, describing 3-Step Sewer Joint Sealing System (including Presstite High-Bond PRIMER).

PRESSTITE SEALING COMPOUNDS

PRESSTITE-KEYSTONE ENGINEERING PRODUCTS COMPANY

K A P

A Division of AMERICAN-MARIETTA COMPANY
3780 CHOUTEAU AVENUE, ST. LOUIS 10, MISSOURI

New Controls For Ladder-Type Ditcher

617

Gar Wood Industries, Inc., Wayne, Mich., has equipped its Model 160 ladder-type ditcher with new hydraulic controls.

Designed for water main and deep sewer excavation, the ditcher is now equipped with a hydraulic boom hoist for fast, positive positioning of the boom. The boom is raised, lowered and held by an independent, package-type hydraulic control system. No friction boom clutch or brakes are required.

Double-acting hydraulic cylinders provide full crowd for the boom. The 160 digs to a depth of 16 feet with widths from 18 inches to 48 inches. Shiftable boom allows the 160 to work close to buildings, utility poles, streets and obstructions. Reverse digging speeds allow undercutting of sidewalks and pipes.

The
FORD
Yokebox
A Better Meter Setting for Shallow Services
A simple, compact meter housing, complete with service valve, for warm climate installations. The modern and better way to install water meters. Gives better protection, keeps meter cleaner. An investment in easier meter reading, longer meter life and greater revenue.
Write for information on the Yokebox.
1. Small lid, clean meter, speeds meter reading.
2. Easy to handle, quickly installed as a unit.
3. Meter changes quick and easy, without cumbersome tools.
4. Service valve easily operated and well protected.
FORD
FOR BETTER WATER SERVICES
THE FORD METER BOX COMPANY, INC. Wabash, Indiana

Anti-Rust Paint For Damp Surfaces

618

Chem Industrial Co., Brooklyn, Ohio, has developed a new special grade of anti-rust paint that is reputed to go on satisfactorily even over damp surfaces.

Known as "88 special", it combines a "heavy" bituminous alkyd base with a special penetrating vehicle. The latter is said to cut through moisture to surface metal. This new paint is recommended for wet weather applications or use where it is virtually impossible to thoroughly dry a metal surface.

"88 special" forms an attractive, shiny black elastic coating that resists dampness, mild industrial acids and fumes, grease, oil drying effects of sun and extreme temperature changes. In addition, it is said to retard the corrosive effects of salt water and salt-laden air.

Indicator-Controller For Remote Operation

619

Builders-Providence, Inc., Providence, R. I., has developed the Synchro-Scan Position Indicator/Controller unit for the operation and position-indication of remotely located valves, gates, feeders, or other devices.

These units permit the remote modulation and continuous indication of valves or similar devices. This is accomplished through the transmitter package, which has a three-position switch mounted on its face to control the device. Above this switch is a small voltmeter-type indicator graduated from 0 to 100% to indicate the percent of opening.

At the receiving end, another packaged unit contains the control relays and the regulated DC voltage supply used to transmit the position indication. Only two wires and a ground are required for transmission of the signal.

Diaphragm Type Pneumatic Pump

620

The Layton Company, Inc., Cudahy, Wis., has developed a new diaphragm type, pneumatic pump for high head pumping.

This light and compact pump

New Subscription Order Card

NOTE THE NUMBERS
they correspond with the
headings in our
EQUIPMENT AND LITERATURE COLUMNS
To receive further information
on any of the listed
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Fill in your name, address, title
and mail!
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Water & Sewage Works

185 NORTH WABASH AVE. CHICAGO 1, ILL.

Gentlemen:

Please enter my new subscription to WATER & SEWAGE WORKS for the period checked below:

☐ Three Years—$10.00 ☐ Two Years—$7.50 ☐ One Year—$5.00

Above rates are for U.S.A. and Canada. Add $1.50 per year for other countries.

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***PLEASE SEND ME INFORMATION ON THE ITEMS CIRCLED BELOW**

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622	623	624	625	626	627	628
629	630	631	632	633	634	635

IF YOU WISH TO RECEIVE FURTHER INFORMATION ON PRODUCTS ADVERTISED OR REFERRED TO IN THE ARTICLES, OF THIS ISSUE—LIST THE PAGE NOS. BELOW.

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WATER & SEWAGE WORKS

JUST
CLIP
THESE
CARDS
MARK
AND
MAIL —
TO
RECEIVE
THE
LATEST
INFORMATION
OR
LITERATURE
DESCRIBED
IN
THIS
ISSUE

READER SERVICE CARD for

WATER & SEWAGE WORKS

Equipment — Products
Information — Literature

ejects fluids with 60% solids and highly abrasive liquids. Fluids and materials are bypassed from suction line directly into discharge outlet and do not contact any working part. It is 22 inches high, 12 inches in diameter and weighs 65 pounds.

The principle of the Layton pump involves a cylinder with resilient diaphragms fastened peripherally to each end. The diaphragms are securely joined by a connecting rod, permitting free, simultaneous flexing up or down. The heart of the cylinder is a stationary, aluminum-alloy barrel which acts as a bearing for the connecting rod and has integral partitions for air valves.

Aluminum Stair Treads

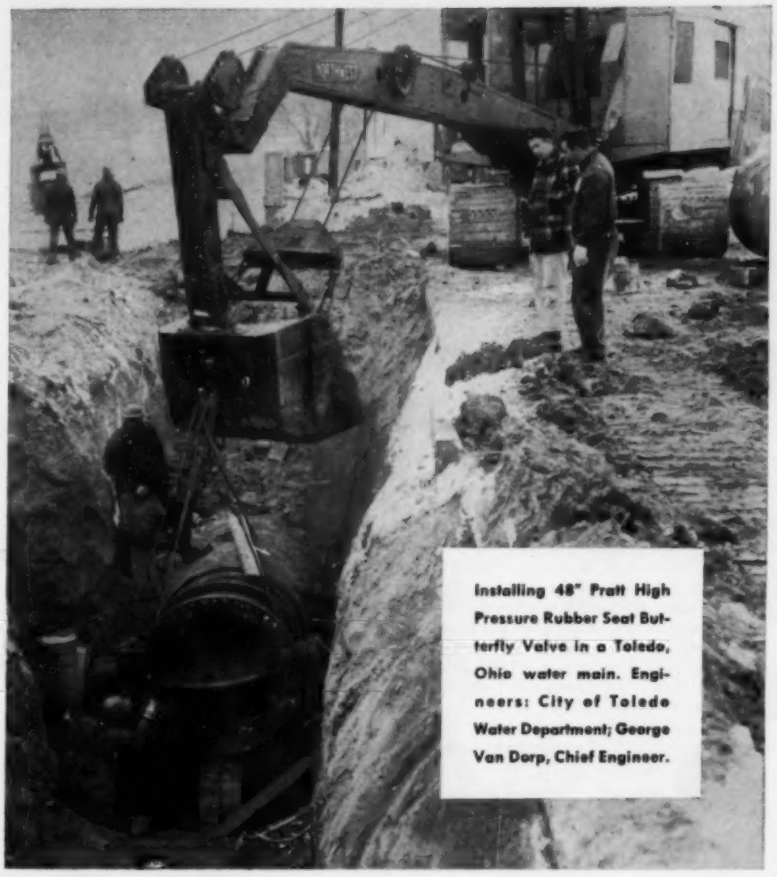
621

Aluminum Company of America, Pittsburgh, Pa., has developed a precision-cast aluminum stair tread that combines safer footing with long-term maintenance savings.

Designed for use where stairs are subject to extreme weathering or corrosive atmospheres, the aluminum die-cast treat utilizes a slip-proof abrasive nosing.

Because the grating is cast in one piece, concentrated loads are distributed more evenly over all bearing bars. Although designed to carry the weight of a heavy man, the stair has withstood loads in excess of 3,000 lbs. Deflection and permanent set have been less than in comparable conventional treads.

It *may* be well to tell the "little lady" everything . . . but, if you do, for Pete's sake tell her *before* someone else does.



Installing 48" Pratt High Pressure Rubber Seat Butterfly Valve in a Toledo, Ohio water main. Engineers: City of Toledo Water Department; George Van Dorp, Chief Engineer.

TOLEDO...Chooses Henry Pratt Butterfly Valves for Water Mains

Long after this valve is buried, in six months or sixty years, it will still be **easily opened or closed by one man using a standard tee-wrench.** The design features of Pratt Valves are aimed at the kind of honest dependability you need for water main use... the disc edge is corrosion-resistant and seats accurately in a rubber liner made extra-heavy to prevent permanent set. The one-piece stainless steel valve shaft rotates in lifetime lubricated bronze bearings, and the operator is permanently lubricated and sealed to withstand seepage.

In 1956, the City of Toledo purchased 13 Pratt Rubber Seat Butterfly Valves for its water mains, in 24", 30", and 48" diameters. All of them were designed for buried service without the need for protective vaults around valve or operator, **adding substantial savings in installation costs** to their proven freedom from maintenance problems.

Pratt engineers stand ready to help you select valves for distribution service or any water works application. Call on them with your next valving problem.

Have you sent for your copy?... of Pratt's 40 page Manual of Rubber Seat Butterfly Valves. Useful—contains latest pressure drop and flow data, conversion tables, butterfly valve theory and application. **Bulletin B-2B.**

HENRY PRATT — RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

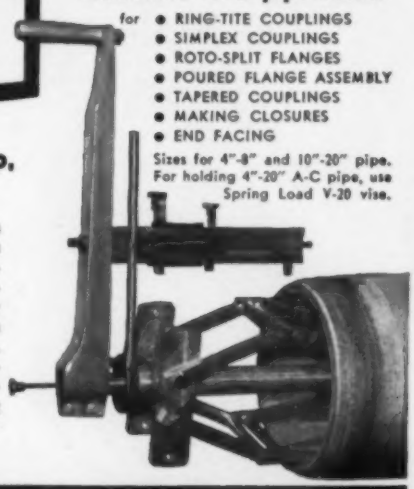
MACHINE A-C PIPE ENDS any profile... on the job!

model B
SPRING LOAD
A-C MACHINING AND TAPERING TOOL

"One-man" precision field tool machines A-C pipe *faster*

for
- RING-TITE COUPLINGS
- SIMPLEX COUPLINGS
- ROTO-SPLIT FLANGES
- POURED FLANGE ASSEMBLY
- TAPERED COUPLINGS
- MAKING CLOSURES
- END FACING

Sizes for 4"-8" and 10"-20" pipe. For holding 4"-20" A-C pipe, use Spring Load V-20 vise.



Eliminates machine shop, lathe, hauling costs!

This portable machining tool makes lathe-smooth, close tolerance profiles for closures up to 9" couplings. Eliminates adapters, trues up pipe. Adjusts in seconds for any profile by simple change of cam plate. Has automatic feed with quick release. Salvages broken and short pieces. Approved by leading A-C pipe manufacturers. Ask for it, and Spring Load A-C Pipe Cutters at your suppliers, or write.

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MANUFACTURING CORP.
3610-E First Ave. So., Seattle 4, Wash.

GUNITE
The Modern Way...

for Repairing, Constructing, Lining:
- Reservoirs
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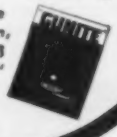
- Filter Plants
- Tanks
- Sewage Disposal Plants
- Stadiums
- Bridges
- Sea Walls
- Swimming Pools

Write for more information, including 48 page "Gunite" booklet.



PRESSURE *Concrete Co.*
FLORENCE, ALA.
315 So. Court Street

Liberty Life Bldg. **CHARLOTTE, N. C.**
33 N. LaSalle Street **CHICAGO, ILL.**
193 Emmet Street **NEWARK 5, N. J.**

W & SW Manufacturers' News

"INFILCO" Elects

P. N. Engle, Board Chairman; J. S. Gustafson, New President.

At a recent meeting of the Board of Directors of Infilco Inc., Mr. P. N. Engel, long time President was elected Chairman of the Board and Mr. J. S. Gustafson was elected as the new President.

J. S. Gustafson

P. N. Engel

For 55 years, Mr. Engel has been active president of Infilco, a company founded by his father in 1896. His dynamic leadership has seen the company grow from a household faucet filter manufacturer to a world renowned designer and producer of high-rate liquid treating equipment. Essentially all of the advanced equipment manufactured and sold by Infilco was developed in its own research laboratories, for it has always been Mr. Engel's policy to surround himself with outstanding talent in each of the sciences relating to the water treatment business.

Majoring in chemistry at Chicago's Armour Institute, "P. N." left school to work in Chicago's Columbus Laboratory. Two years later he became associated with Fuller & Fuller, then a leading distributor of heavy chemicals. During this time he devoted evenings and week-ends to the increasing problems of the small domestic filter company which his father had founded in 1896. He left Fuller & Fuller in 1902 to become production, development, sales, engineering, financial, and legal light of the then tiny International Filter Co.

The keynote of his policies was sounded with the employment, as head of a constantly growing Research Department, of the promising young man who had been his instructor in chemistry at Armour Institute. Ever seeking to discover and encourage new talent for the invention and improvement of methods of liquids

treatment, "P. N's" insatiable curiosity has provided a constant challenge to the ingenuity of his technical staff.

Typical of Mr. Engel's foresight and business acumen was the early invention of, and novel marketing scheme for, equipment for accurately and uniformly softening water used in ice manufacture. This equipment was sold to an estimated 90% of the ice plants in the country.

Infilco later expanded its activities into the fields of municipal water supply filtration, industrial process and boiler feed treatment, sewage, and industrial wastes treatment as well as water purification equipment for the beverage industry and for swimming pools. After a long series of painstaking studies and experiments, a piece of equipment was perfected for rapid rate treatment of liquid by coagulation and recirculation. This patented device, the Accelator®, was the first of an extensive line of high-rate equipment developed by Infilco in the fields of municipal and industrial water, sewage, and industrial wastes treatment.

During the last half century, P. N. Engel has not only the guiding genius of Infilco, but has become known as dean of the water purification industry.

Mr. J. S. Gustafson, the new President of Infilco, who impresses one as a man of vision and determination, received his education in finance and business administration at Northwestern University, supplemented by advanced finance work and engineering courses at De Paul, Loyola, and Wayne Universities. During World War II he served in the navy, and, upon his release, Mr. Gustafson joined the staff of Touche, Niven, Bailey and Smart, where he advanced to become manager of the Special Services Department, devoted to systems, procedures, and as consultants in industrial management.

In 1951, he became Treasurer of Infilco and, in the following year, Vice President of the company. In 1953 he became Executive Vice President, an office which he held until his recent election as President of the company.

Mr. Gustafson thus becomes one of that small group of outstanding younger executives on whose shoulders rest the responsibilities of operation of companies of world-wide importance.

They Say:

A man's condition is best judged by which he takes two of at a time—STAIRS OR PILLS?

E. R. P. CATHODIC PROTECTION . . .

individually designed for each application

An effective installation that operates at the lowest cost per year requires experienced engineering evaluation of site and environmental conditions. The Electro Rust-Proofing Engineering Division makes available to you the cumulative experience gained in designing more than 10,000 cathodic protection systems.

Electro Rust-Proofing can furnish any one, or all, of the following services to help you provide proper cathodic protection for each of your jobs:

- Corrosion surveys and recommendations
- Design based on engineering experience
- Cathodic protection equipment and installation
- Service to assure proper operating results

For additional information write today.

ERP CATHODIC PROTECTION SINCE 1935

ELECTRO RUST-PROOFING CORP.

A SUBSIDIARY OF WALLACE & TIERNAN INC.

30 MAIN STREET, BELLEVILLE 9, NEW JERSEY

CABLE: ELECTRO, NEWARK, N. J.

E-35R

CHLORINATORS and CHEMICAL FEEDERS

for

- slime elimination
- water treatment and purification
- industrial waste and sewage treatment

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

CD-41

Foster Company Adds Two To Atlanta Office

L. B. Foster Company, Pittsburgh, Pa., has announced that two additions have been made to the Atlanta office staff.

William B. Hundley, Jr., has joined the sales force. For the past six years he was warehouse steel salesman in Atlanta and Toledo, Ohio. He is a graduate of the University of Toledo.

Edwin E. Webster has been appointed head of the order department. He had been in the freight traffic department of the Southern Railway System for four and one-half years, and was previously employed by the Great Southern Trucking Co., Atlanta.

Diamond Alkali Promotes Davis

Diamond Alkali Company, Cleveland, Ohio has announced the promotion of Jack E. Davis to the post of special Staff Assistant in the Sales Department.

Davis comes to his new position following nearly 11 years' experience as a member of the Company's Philadelphia Branch Sales Staff. He joined the Diamond organization in September, 1939 as a sales clerk in Pittsburgh and was transferred to Painesville the following year.

Layne & Bowler Names New Officers

Layne & Bowler, Inc., Memphis, Tennessee, has announced that William H. Reeves has been named president. Mr. Reeves has been vice president for the past 15 years.

At the same time Mr. James U. Seay, president since 1945, was named chairman of the board. Frank T. Quinn was named vice president in charge of manufacturing; A. O. Fabrin, vice president in charge of engineering. L. G. Ost was re-elected secretary-treasurer and M. H. Sandstrom, assistant secretary-treasurer.

Graver Tank Celebrates Its 100th Anniversary

Graver Tank and Mfg. Co., Inc., East Chicago, Indiana, is celebrating its 100th anniversary this year. The company has grown from an organization that employed only the two Graver brothers, who founded the firm, to the more than 4,000 people employed today.

The company has also announced that it will offer prizes for the following type of information: 1) where is the oldest Graver tank still in use; 2) who has the oldest picture of a Graver tank; and 3) the best idea of decoration of a Graver tank or tanks (either in existence of planned). All information and pictures must be mailed to the centennial committee, Graver Tank and Mfg. Co., Inc., East Chicago, Indiana before November 1st, 1957.

Carlton Crumb of Dorr-Oliver Dies

Dorr-Oliver Incorporated, Stamford, Conn., has announced that Carlton W. Crumb, Director of Technical Data, passed away in April, at Stamford, Conn., following a brief illness.

A member of the Dorr-Oliver staff for almost thirty years, Mr. Crumb, at the time of his death, was responsible for worldwide dissemination and exchange of technical information within the parent company and its nine subsidiary organizations abroad.

R. D. Wood, Leader Since

A Low-Cost Hydrant You Can Depend On

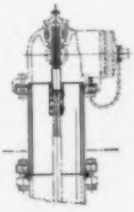
The R. D. Wood Standard Swivel Joint Hydrant gives you the most for your money in strength, reliability and sound design. The *all-bronze stuffing box*, gland and operating nut prevent rust and corrosion. Internal friction which might lower pressure is reduced to well below A.W.W.A. specifications by tapered nozzleways and carefully rounded changes in diameter.

Breakable Flange and Stem Coupling

Available at slight extra cost. Designed to snap under a blow which would otherwise smash the hydrant, flange and stem coupling can be inexpensively and quickly replaced without excavation.

Extension Piece

Can be inserted without interrupting water flow.



Hydrants now available with O-Ring Seal when specified

S. Morgan Smith Valve Division Appointments

The S. Morgan Smith Company, York, Pennsylvania, has announced several recent personnel appointments within the Valve Division of the firm.

Frank C. Zirnkilton has assumed the duties of Manager of Field Sales, Valve Division; James F. Winters has been named Chief Engineer of the division, and Joseph H. Boigegrain has been transferred to the West Coast office of the division as Sales Engineer for water works in the state of California.

Mr. Zirnkilton joined S. Morgan Smith Company in 1951 as Company pilot and head of Air Transportation. Following a tour of duty as Lt. Commander in the U. S. Navy Reserve, he became an Application Engineer in the Valve Sales Department, the position he held until his present appointment.

Mr. Winters began his employment with the York firm in 1946, and Mr. Boigegrain in 1953.

Layne & Bowler, Inc. Celebrates 75th Anniversary

Layne & Bowler, Inc. Memphis, Tenn., celebrating its 75th anniversary this year, was founded in 1882 by Mahlon Layne in the area

Mahlon Layne—Founder

of the Dakotas. In 1901 the firm expanded to Texas, where a centrifugal pump that could be installed in well castings yet big enough to do the job, was developed. This pump could be adjusted and lubricated from the surface; one that did not require a man to climb into the well pit and repack. It was also around this time that a well screen or strainer was developed that would allow water to pass into the well, yet which would not become sand-clogged.

In 1913 the main office and factory of the company was moved to Memphis, Tenn., where in 1922 a plan of decentralization was put into effect which located Layne facilities at stragetic points over the world. Associate companies were formed and experienced personnel with the organization were given key jobs with these associate firms.

In 1927 M. E. Layne, the founder, died and Lloyd F. Layne was president until 1933. He was succeeded by J. G. Gordon Jr., who retired in 1945. J. I. Seay served as president until 1957 when he became chairman of the board. W. H. Reeves is now president.

1803, Presents

A Gate Valve Built for Generations of Trouble-Free Operation

The R. D. Wood Gate Valve can be depended on to work and keep on working for years. It is simply constructed—a spreader and two discs are the only moving parts. The discs are free to revolve their full circumference, preventing uneven wear on faces and seats. When fully open, gates are entirely clear of flow.

R. D. Wood Gate Valves now available with O-Ring Seal when specified

all available with mechanical joint and flange-type pipe connections

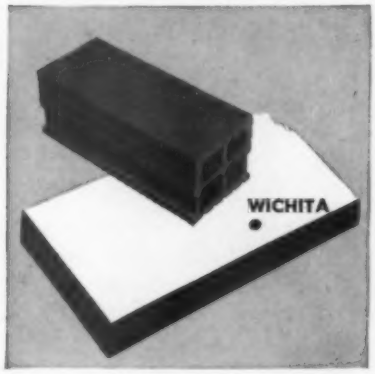
R. D. WOOD CO.

Public Ledger Building, Independence Square • Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

NOW, they're just going too far with this automation business.

Another NEW Leopold Installation...



Leopold Filter Bottoms selected for 32 mgd Wichita, Kan. plant!

In addition to this recent installation, Leopold Compound Duplex Filter Bottoms are giving dependable, economical performance in well over 300 plants (with a daily capacity of more than 1¼ billion gallons). And the number of Leopold-equipped facilities is growing by leaps and bounds.

Whether you're modernizing your present plant or planning new construction, it will pay you to consider the many features offered only by Leopold Tile Filter Bottoms. They resist corrosion, are not subject to tuberculation, require only small sized gravel, are acid and alkali resistant, provide equal and uniform filtration, and will last indefinitely. Want more details? Write us today.

For TOP performance, use Leopold Bottoms

Leopold

F. B. LEOPOLD CO., INC.
227 South Division Street,
Zelienople, Pa.

COMPLETE WATER PURIFICATION AND SEWAGE PLANT EQUIPMENT!

Tepas Promoted by Olin Mathieson

Olin Mathieson Chemical Corp., Baltimore, Md., has announced the appointment of Joseph J. Tepas to the market development department of the Industrial Chemicals Division. He will specialize in the sanitation and water treatment fields.

Mr. Tepas had been technical representative for the company's hypo-chlorite products. In recent years, he had been closely associated with the development of chemical water treating materials for home swimming pools and sanitizing agents for the dairy and food industries.

Prior to joining Olin Mathieson in 1946, his most recent association has been with Dr. L. D. Goodhue at the U. S. Department of Agriculture Research Center at Beltsville, Md., where he worked on the development of aerosol insecticides.

Olin Mathieson Makes Changes In Chemicals Division Sales Force

Olin Mathieson Chemical Corp., Baltimore, Md., has announced the following changes in the field sales organization of the Industrial Chemicals Division.

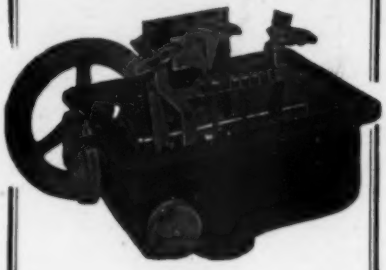
W. D. Marshal, who has been district manager in the Philadelphia sales office, is being assigned to new sales duties of a special nature.

He is succeeded as district manager of the Philadelphia territory by J. G. Johns, who has been with the company in various sales capacities for 16 years.

Victor C. Fusco has been appointed a sales representative in Pittsburgh, working under Mr. Johns. He will represent the division's full line of industrial Chemicals in that area.

Don Threlkeld has been appointed a sales representative in the Chicago office under N. F. Wilmot, Chicago district manager. A chemical engineer, Mr. Threlkeld has been employed in the company's organic chemicals plant at Brandenburg, Ky., and prior to that in the research department at Niagra Falls, N. Y.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION
HEALY-RUFF COMPANY
783 Hampden Ave., St. Paul 4, Minn.

Surer Gland Lubrication for Centrifugal Pumps

THE Z-F GREASE SEAL eliminates that trouble spot where shaft enters casing. Applies constant positive lubrication to packing and shaft—automatically. Excessive heat, rapid wear, leakage and scoring will disappear as the Grease Seal applies a constant flow of lubrication when pump starts until it stops—automatically. Many other advantages, too. Write for complete description and price. **ZIMMER and FRANCESCON, Moline, Illinois.**

ZF

W&SW

New Literature

Laboratory Furniture

622

Fisher Scientific Company, Pittsburgh, Pa., has just published a 24-page fully-illustrated bulletin describing and giving detailed specifications for over two dozen interchangeable **Direct-From-Stock Furniture Units** for laboratories.

A handy feature of the bulletin is a section devoted to simple, expert instructions on how to plan a laboratory, how to select rooms and units, and how to handle installations.

Submersible Pump Maintenance Guides

623

Byron Jackson Pumps Inc., Los Angeles, Calif., has available two charts that serve as guides for frequency of **Submersible Pump Check Periods and Preventative Maintenance.**

This bulletin explores what is necessary for continuous trouble-free submersible pump service. Among the items covered by the bulletin are: intervals between check periods; number of years until preventative maintenance; definitions; type of uses; check period procedure; and indications for preventative maintenance.

Pump Maintenance Record Card

624

Goulds Pumps, Inc., Seneca Falls, N. Y., has designed a **Pump Maintenance Record Card** which provides for complete information on installation, application and maintenance. Space is provided on each card, using both sides, to keep a complete record for a period of years.

Complete maintenance records, filed in an accessible location, are invaluable in diagnosing pump failure, in ordering repair parts, in establishing lubrication and maintenance scheduling. In addition, they are valuable in determining pump suitability for new requirements. Notations of pump failures and the repair required can be used to define the optimum period of any given pump before complete inspection and overhaul is required.

APCO

Super De Lavaud

CAST IRON PIPE

Alabama's Super De Lavaud Cast Iron Pipe for long years of dependable, trouble free service.

For water, gas and sewage.

In sizes of 3" to 24". Modern long lengths. Bell and spigot, roll-on-joint, mechanical joint and flanged.

ALABAMA PIPE COMPANY

We invite inquiries to our nearest sales office.

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122 South Michigan Avenue
Chicago 3, Illinois

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New York 1, New York

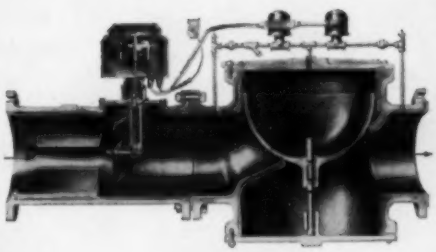
Sparling Meters

FOR INFALLIBLE MEASUREMENT OF WATER

The meter that measures and regulates flow

SPARLING METRO VALVE

Combines a Sparling Main-Line Meter and a Sparling Hydrovalve. You get automatic volume regulation with instantaneous totalization—all in one compact unit. Valve position set volumetrically by the flow of water through the meter.



MAIL COUPON TODAY!

SPARLING METER COMPANY INC.
225 N. Temple City Blvd., El Monte, Calif.

ATLANTA 3, 66 Luckie St. N.W.
CHICAGO 4, 220 So. State St.
CINCINNATI 2, 626 Broadway
DALLAS 1, 505 No. Ervay St.
KANSAS CITY 6, MO., 6 E. Eleventh St.
ROMFORD, ENGLAND
LOS ANGELES 54, 945 No. Main St.
ROSELLE, N. J., 650 First Ave. West
SAN FRANCISCO 24, 85 Industrial St.
SEATTLE 99, 904A Elliott West
TORONTO, CAN., 207 Queens Quay West
248 London Rd.

REQUEST FOR LITERATURE

Sparling Meter Company, Inc.
225 N. Temple City Blvd., El Monte, Calif. WSW-6

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ADDRESS _____

CITY _____ STATE _____

N-SOL (ACTIVATED SILICA)
SOLVES THESE WATER PROBLEMS . . .

- POOR QUALITY
- TURBIDITY
- COLOR
- HIGH CHEMICAL COSTS
- COLD WATER COAGULATION
- SHORT FILTER RUNS

N-Sol (activated silica sol) with your regular coagulant forms large, strong, rapid-settling floc and delivers clear, sparkling water. Evaluate results in your plant.

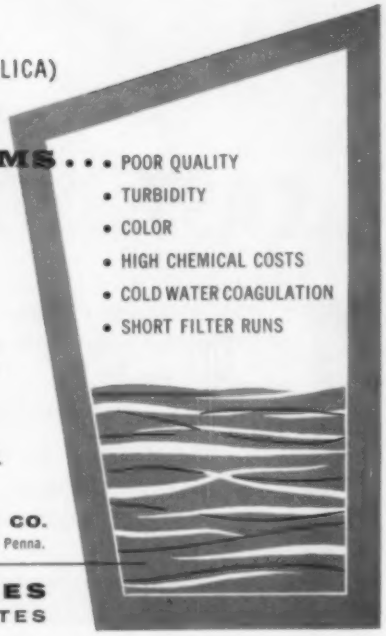
SAMPLES OF N SILICATE AND DIRECTIONS FOR JAR TESTS ON REQUEST.*

*N-Sol is made in your plant from our N sodium silicate (shipped in drums or tankcars).

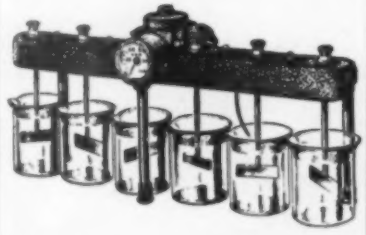
TRADEMARKS REG. U.S. PAT. OFF.

PHILADELPHIA QUARTZ CO.
1166 Public Ledger Building, Philadelphia 6, Penna.

N-SOL PROCESSES
PQ SOLUBLE SILICATES



P & B Multiple Stirrer



When several samples are mixed simultaneously under identical conditions the optimum concentration of flocculent may be quickly selected and translated to plant quantities . . . The mixer takes 1,000 ml. beakers. Speeds from 15 to 100 r.p.m. are standard.

Write: **Cat. No. 77-700**

Phipps & Bird, Inc.
P. O. Box 2V Richmond 5, Va.

Lasts longer, costs less

modern POOL-COTE Paint

Special formula for concrete and metal pools

- **Easy to apply, dries overnight.**
- **Chlorinated rubber base guaranteed not to flake or powder.**
- **Inhibits algae growth, resists water-treatment chemicals.**
- **Ten long-lasting colors.**

Guaranteed by world's leading manufacturer of pool equipment and products; famous for quality since 1935. Can't be equalled for value *anywhere!*

Write for FREE catalog 15C—describes pool equipment and products, over 100 items!
For nearest distributor consult your classified directory or write us.

modern SWIMMING POOL CO., INC.
1 Holland Avenue, White Plains, New York
Manufacturers of Swimming Pool Supplies Since 1935

Millivoltmeter Recorder

625

The Bristol Company, Waterbury, Conn., has released a bulletin on a **Portable Millivoltmeter Recorder** for use in electrolysis survey work.

The 4-page bulletin describes the use of the instrument in surveys of electrolytic corrosion and deterioration of underground structures such as pipe and cables. A bibliography on actual testing methods and their significance is included.

Pneumatic Conveyors

626

U. S. Hoffman Machinery Corp., New York, N. Y., has just published a brochure on **"Hoffco-veyer" systems,** which describes the company's systems for conveying dry, free-flowing materials.

This 8-page brochure details the reasons for installing this system, the basic types available, successful installations in operation, and a complete run-down on the details of installation and possible applications.

How To Prolong V-Belt Life

627

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has just published a 12-page bulletin on how to obtain **Longer Belt Life** by exercising simple precautions.

The bulletin describes various types of V-belts and tells how to select and match them. It lists seven steps for the correct installation of belts and offers as many hints for making them last longer.

Portrayed are eight most common causes of V-belt destruction. These include snub break, slip burn, base cracking, abrasion, oil deterioration, rupture, ply separation, and work sides.

Nozzle-Matic Centrifuge

628

The De Laval Separator Company, Poughkeepsie, N. Y., has available a new bulletin describing the **Nozzle-Matic Centrifuge.**

According to the bulletin, the unit is used to separate, clarify, classify, or concentrate liquid of liquid-solid moisture high in solid content, and will continuously discharge all phases including the solids. The bulletin also describes the applications for this machine and gives flow charts showing the various types of nozzle bowls available.

Chemical Resistant Concrete Pipe Coating

629

Hamilton Kent Manufacturing Co., Kent, Ohio, has available a 4-page, 2-color bulletin on **Rexon Coating No. 2.**

The bulletin describes this chemically resistant concrete pipe coating as a method of protecting concrete pipe, inside and out, from corrosive attack. It lists 12 facts about the coating that describe the use of the coating and how it is applied. Two tables present the results of many tests on the chemical resistance of the coating, and additional listings provide information on quantities needed, shelf life, and costs.

The back page is devoted to techniques of surface preparation; activation and mixing; application; and vulcanization.

Super Tumblast Cleaners

630

Wheelabrator Corporation, Mishawaka, Ind., has just issued two 12-page catalogs containing detailed descriptions of additional sizes of the new **Wheelabrator Super Tumblast.**

The catalogs make use of colorful cutaway drawings to illustrate and describe each of the new features that have been incorporated into these machines. Complete construction details and mechanical specifications are presented in an easy to read, easy to understand manner. These cleaners have proven useful in cleaning meters and other metal products.

Industrial Gas Chromatograph

631

Beckman Instruments, Inc., Process Instruments Div., Fullerton, Calif., has released a 4-page brochure describing the new Beckman **Industrial Gas Chromatograph.**

According to the brochure this is one of the first instruments to bring the simplicity and dependability of gas chromatography to process instrumentation. It has been specifically designed for the continuous, automatic analysis of process streams, using a unique sampling valve and timing system. An installation drawing and anexplanation of the bar-graph control process are also included.

Selecting Power For Pumping

632

Caterpillar Tractor Co., Peoria, Ill., has just released a 12-page handbook on **Selecting Power for Pumping.**

The handbook contains a checklist of features necessary for continued dependable operation on pumping jobs. Step-by-step, the checklist describes the proper requirements which an engine must have, backing them with illustrations and examples of efficient installations. It is an excellent aid to anyone who wishes to match the proper engine to his pumping requirements.

Ovaloid Tanks

633

R. D. Cole Manufacturing Company, Newnan, Ga., has available a folder on **Cole Ovaloid Tanks** for water storage.

This 4-page folder contains photographs of over 14 different tank installations of various capacities. A table giving capacity in gallons, dimensions and cu. yds. foundation average is also included.

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Clamps For Plastic Pipe

634

Wittek Manufacturing Co., Chicago, Ill., has available a catalog page on **All Stainless Steel Sure-Tite Clamps** for plastic pipe.

The catalog page shows general specifications and descriptive data on the clamps. Sizes, part number, list price and weight are given in table form on the back of the page.

Eimco Tractor Operator's Manuals

635

Eimco Corporation, Salt Lake City, Utah, has published two new manuals for operators of The **Eimco Tractor-Excavator,** and the Eimco Model 105 Front end Loader.

The new manual on the Tractor-Excavator offers tips for efficiency in operation of the tractor as well as detailed information on preventive maintenance to extend the tractor's usefulness. The 24-page, three-color brochure is illustrated with numerous pictures emphasizing the role of the operator in obtaining maximum performance and usage. Safety precautions also are emphasized.

The Front End Loader booklet is a four-page illustrated pamphlet which also delineates efficient operation of the attachment recently put under assembly line production as an additional tool for the basic Model 105 tractor. The booklet also offers tips on operation of the fork lift attachment, a hydraulically operated tool which is interchangeable with the bucket of the front end loader.

Industrial Chemicals

636

Tennessee Corporation, Atlanta, Ga., has available a 4-page folder in the company's **Chemicals For Industry—Agriculture.**

The folder discusses in detail the uses and applications of copper sulfate, Ferri-Floc, and liquid sulfur dioxide. Also included in the folder are descriptions of the various forms of manganese, zinc, iron, sulfur and copper produced by the company.

Concrete and Masonry Repair

637

Permagile Corp. of America, Long Island City, N. Y., has published a brochure entitled **"Permanent Repair and Restoration of Cracked and Spalled Concrete and Other Masonry Structures."**

It gives detailed instructions for performing such work with Permagile epoxy-based industrial polyplastic alloys. Types of structures covered include buildings, grain elevators and bins, tanks and vats, sewers, and water-system chambers.

Thread Seizures

638

Surveys Inc., Trenton, N. J., has just published a new engineering data bulletin that highlights mechanical and chemical causes of **Thread Seizures,** as encountered in metal and oil refineries, chemical plants, power and steam generating stations.

The bulletin offers technical data and recommendations.

Barrel Pump

639

Milton Roy Company, Philadelphia, Pa., has recently published a bulletin on their new controlled volume **Barrel Pump.**

This single sheet, 2-page bulletin describes the advantages of the pump in combined pumping and metering of toxic or corrosive chemicals from barrels or drums.

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The bulletin includes complete specifications and dimensions for handy reference.

Plastic Valves and Pipe Fittings

640

Walworth Company, New York, N. Y. has just published a 16-page illustrated bulletin describing the **Walworth Polyvinyl Chloride Valves and Fittings.**

The bulletin presents 4-pages of application tables on the performance of normal impact PVC and high impact PVC valves and fittings for handling about 315 different fluids that attack other materials.

A cutaway of a PVC Y-globe valve plus text details nine design features for long-time control of corrosive fluids. Four tables give data on physical properties, recommended working pressures and effect of temperature on working pressure.

The fittings for threaded and welded pipe are shown in line drawings with dimension and weight information for each. The bulletin concludes with installation and assembly guides for PVC piping systems.

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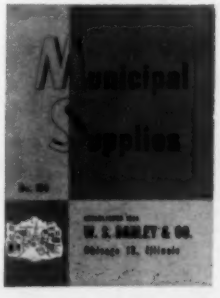
Flowmeter Data Sheet

641

Leeds & Northrup Company, Philadelphia, Pa., has available a new 4-page product data sheet describing the **"Centrimax" Flowmeter.**

The data sheet schematically illustrates the operation of the instrument and lists applications in the field. An interior view of the Centrimax is shown and the various components identified. Concluding the Speedomax round chart and strip chart recorders.



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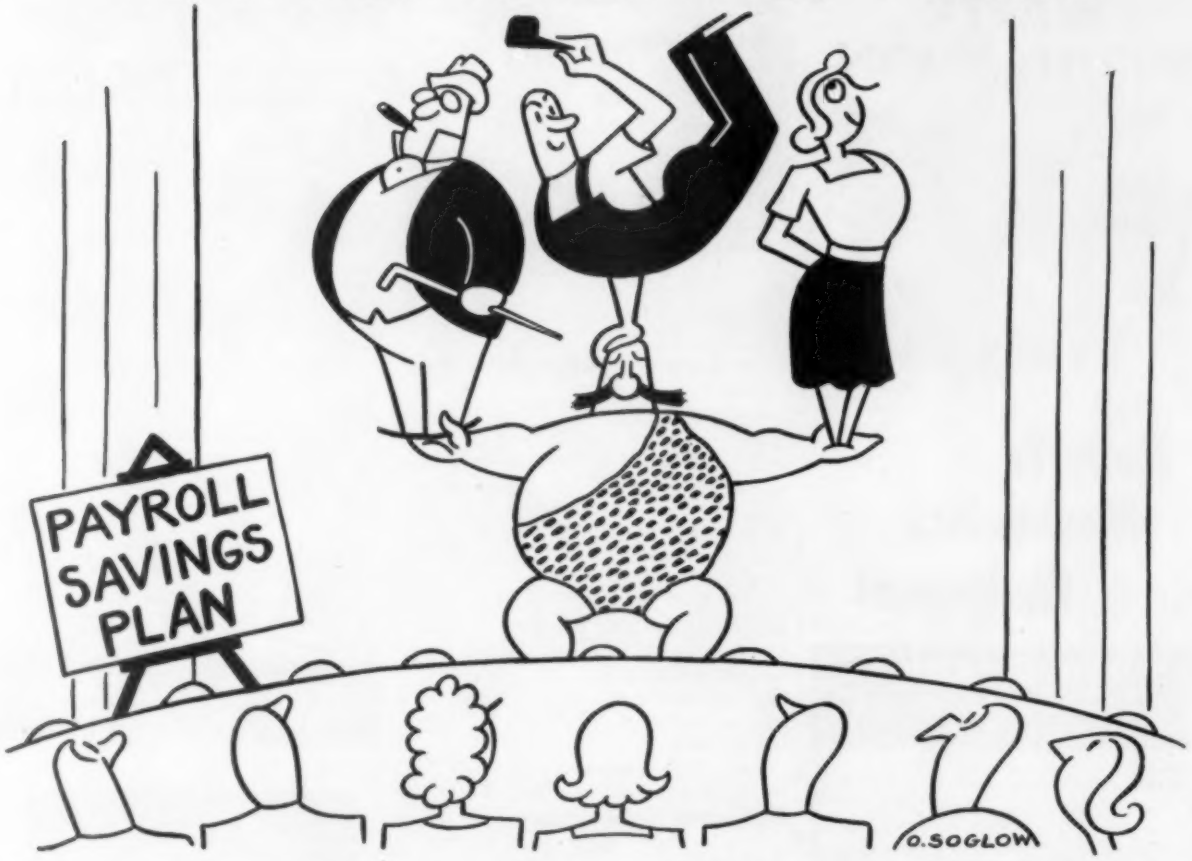

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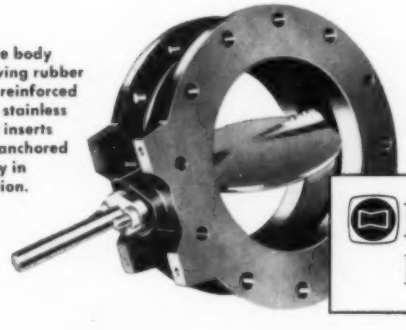

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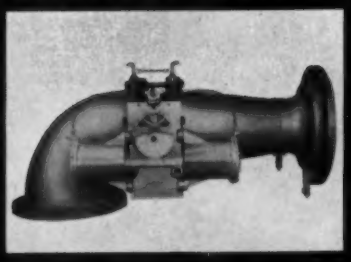

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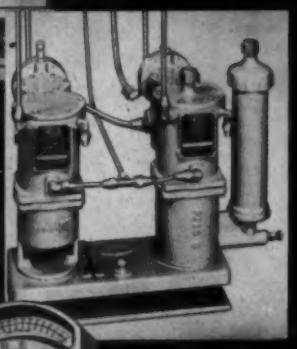

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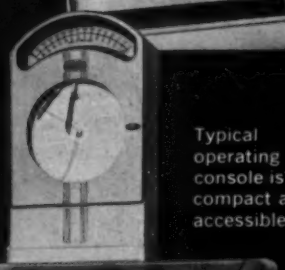

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